I45.11: 930/04 no.6

Clemson University
3 1604 019 781 824

U. S. DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES

PROPAGATION AND DISTRIBUTION OF FOOD FISHES, 1930

By GLEN C. LEACH

FISHERIES DOCUMENT No. 1098

Clemson ... Government Publications

U. S. DEPARTMENT OF COMMERCE
R. P. LAMONT, Secretary
BUREAU OF FISHERIES
HENRY O'MALLEY, Commissioner

Bureau of Fisheries Document No. 1098

PROPAGATION AND DISTRIBUTION OF FOOD FISHES

FISCAL YEAR 1930

By GLEN C. LEACH

APPENDIX XVI TO REPORT OF COMMISSIONER OF FISHERIES
FOR THE FISCAL YEAR 1930

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1931

For sale by the Superintendent of Documents, Washington, D. C. - - - - - Price 15 cents

PROPAGATION AND DISTRIBUTION OF FOOD FISHES, FISCAL YEAR 1930[1]

By Glen C. Leach, *Chief, Division of Fish Culture*

CONTENTS

	Page
Introduction	1125
Part 1.—Fish Production: Propagation and Rescue Work	
Species handled	1126
Output	1127
Cooperation with other conservation agencies	1128
Cooperative fish nurseries	1129
State fish-cultural activities	1132
Salvage of food fishes	1135
Transfers of eggs between stations	1136
Shipments to foreign countries	1137
Output of stations and substations	1137
Egg collections	1143
Fish-cultural notes	1145
New stations	1145
Five-year expansion program	1146
Fish food	1146
Refrigerating plant for fish food	1146
Black-spotted trout egg collections Pyramid Lake, Nev	1146
Distribution by truck	1147
Effect of weather conditions on fish culture	1147
Commercial species	1148
Pacific salmons	1148
Afognak (Alaska) station	1148
Yes Bay (Alaska) station	1149
Birdsview (Wash.) station and substations	1149
Birdsview (Wash.) station	1150
Baker Lake (Wash.) substation	1150
Duckabush (Wash.) substation	1150
Quilcene (Wash.) substation	1151
Walcotts Slough (Wash.) substation	1151
Sultan (Wash.) substation	1151
Lake Crescent (Wash.) State trout hatchery	1151
Quinault (Wash.) station	1152
Clackamas (Oreg.) station and substations	1153
Clackamas (Oreg.) station	1153
Little White Salmon (Wash.) substation	1153
Big White Salmon (Wash.) substation	1153
Rogue River (Oreg.) substation	1154
Applegate Creek (Oreg.) substation	1154
Salmon (Idaho) substation	1154
Baird (Calif.) station and substations	1154
Battle Creek (Calif.) substation	1155
Mill Creek (Calif.) substation	1155

[1]Appendix XVI to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1098. Submitted for publication Oct. 27, 1930.

Commercial species—Continued. Page
Fishes of the Great Lakes 1155
Duluth (Minn.) station 1156
Northville (Mich.) station and substations 1156
Northville (Mich.) station 1156
Charlevoix (Mich.) substation 1156
Alpena (Mich.) substation 1157
Put in Bay (Ohio) station 1157
Cape Vincent (N. Y.) station and substations 1158
Watertown (N. Y.) cooperative substation 1158
Barneveld (N. Y.) cooperative substation 1158
Ithaca (N. Y.) substation 1158
Swanton (Vt.) substation 1158
Rescue operations 1158
La Crosse (Wis.) station and substations 1159
Bellevue (Iowa) substation 1159
Marquette (Iowa) substation 1159
Lynxville (Wis.) substation 1159
Homer (Minn.) substation 1159
Upper Mississippi Wild Life Refuge 1160
Marine Species 1161
Boothbay Harbor (Me.) station 1161
Gloucester (Mass.) station 1161
Woods Hole (Mass.) station 1162
Anadromous species, Atlantic coast 1162
Fort Humphreys (Va.) substation 1163
Edenton (N. C.) station and substation 1163
Weldon (N. C.) substation 1163
Craig Brook (Me.) station 1164
Fishes of minor interior waters 1164
Rocky Mountain trout stations 1165
Bozeman (Mont.) station and substations 1165
Bozeman (Mont.) station 1165
Meadow Creek (Mont.) substation 1165
Glacier Park (Mont.) substation 1166
Miles City (Mont.) substation 1166
Leadville (Colo.) station and substation 1167
Creede (Colo.) substation 1167
Yellowstone National Park (Wyo.) substation 1167
Saratoga (Wyo.) station 1168
Spearfish (S. Dak.) station and substation 1169
Crawford (Nebr.) substation 1169
Springville (Utah) station 1170
New England trout stations 1170
Berkshire (Mass.) trout hatchery 1170
Craig Brook (Me.) station and substation 1171
Grand Lake Stream (Me.) substation 1171
St. Johnsbury (Vt.) station and substation 1171
York Pond (N. H.) substation 1171
Pittsford, (Vt.) station 1172
Nashua (N. H.) station 1173
Combination trout and pond stations 1173
Erwin (Tenn.) station 1173
Manchester (Iowa) station 1174
Neosho (Mo.) station and substations 1174
Bourbon (Mo.) substation 1174
Langdon (Kans.) substation 1174
White Sulphur Springs (W. Va.) station 1175
Wytheville (Va.) station 1175
Pond fish stations 1176
Cold Spring (Ga.) station and substations 1176
Harris ponds (Ga.) substation 1176
Valdosta (Ga.) substation 1176
Edenton (N. C.) station 1176
Louisville (Ky.) station 1177
Mammoth Spring (Ark.) station 1177
Orangeburg (S. C.) station 1177

Fishes of minor interior waters—Continued.
Pond fish stations—Continued. Page
San Marcos (Tex.) station and substations 1178
Lake Worth (Tex.) substation 1178
New Braunfels (Tex.) substation 1178
Medina Lake (Tex.) substation 1178
Tupelo (Miss.) station and substation 1178
Aliceville (Ala.) substation 1179
Lakeland (Md.) ponds 1179
Central Station and Aquarium, Washington, D. C 1179

Part 2.—Distribution of Fish and Fish Eggs

Method of distribution 1182
New distribution car 1183
Trout distribution 1184
Cooperation with the United States Forest Service 1185
Distribution cars 1187

INTRODUCTION

It is gratifying to report an all-time high record for the distribution of fish and eggs from the hatcheries operated by the division of fish culture during the fiscal year 1930. The division submits this report with the full knowledge that a detailed analysis of the various items comprising this huge total is necessary to present properly a picture of the real significance of the operations.

The popular conception of the bureau's fish-cultural work, based only upon a limited knowledge of the game-fish hatcheries in the interior and the distribution of these species on private applications, must be overcome. It is essential to make the fact known that the bureau's fish-cultural activities are not alone designated for the benefit of the angler and the casual fisherman but also for the purpose of furthering an important industry and for augmenting the food supply of the Nation.

When the analysis of the distribution records shows an output of over 6,000,000,000 cod, haddock, pollock, flounder, mackerel, etc., the question may arise as to the utility of this activity. It should be borne in mind that the three marine stations propagating these forms are operating at a negligible cost, not greatly in excess of the cost of buying the trout food utilized at the game-fish hatcheries. Again, in considering items of over 150,000,000 each of whitefish and pike perch the fact should be kept clearly in view that the stations in the Great Lakes area propagating these forms also are propagating other commercial forms as well as large numbers of game fish, particularly trout, during a period of the year. It has been stated in previous reports that no definite evaluation of the results attained from the operation of Federal hatcheries is possible. During the past year the passage by Congress of a 5-year expansion program, with over 30 items providing for the expansion of existing fish-cultural activities or the establishment of new ones, is an indication of the conviction of that body relative to the value of Federal fish-cultural work. Such conviction on the part of Congress is, of course, to a great extent, a reflection of the sentiment and viewpoint of the country at large, which viewpoint is further attested by the constantly increasing flood of applications for game fish.

Part 1.—FISH PRODUCTION: PROPAGATION AND RESCUE WORK

SPECIES HANDLED

There is practically no fish sought by the anglers which is not propagated at some of the bureau's hatcheries. The list of commercial species propagated comprises practically all forms whose characteristics are such that they are amenable to methods of artificial propagation. The list appearing below includes 44 varieties.

CATFISHES (SILURIDÆ):
- Catfishes (Leptops sp.).
- Horned pout (*Ameiurus nebulosus*).

SUCKERS (CATOSTOMIDÆ): Buffalofish (Ictiobus sp.) and suckers (Catostomus sp.).

CARP (CYPRINIDÆ):
- Common carp (*Cyprinus carpio*).
- Goldfish (*Carassius auratus*).

SHAD AND HERRING (CLUPEIDÆ):
- Shad (*Alosa sapidissima*).
- Glut herring (*Pomolobus æstivalis*).

SALMONS, TROUTS, AND WHITEFISHES (SALMONIDÆ):
- Common whitefish (Coregonus sp.).
- Cisco (*Argyrosomus artedi*).
- Chinook, king, or quinnat salmon (*Oncorhynchus tschawytscha*).
- Chum salmon (*Oncorhynchus keta*).
- Humpback salmon, pink salmon (*Oncorhynchus gorbuscha*).
- Silver salmon, coho salmon (*Oncorhynchus kisutch*).
- Sockeye, blueback, or red salmon (*Oncorhynchus nerka*).
- Steelhead salmon (*Salmo gairdneri*).
- Atlantic salmon (*Salmo salar*).
- Landlocked salmon (*Salmo sebago*).
- Rainbow trout (*Salmo shasta*).
- Golden trout (*Salmo rooseveltí*).
- Black-spotted trout, redthroat trout (*Salmo lewisi*).
- Loch Leven trout (*Salmo levenensis*).
- Lake trout, Mackinaw trout (*Christovomer namaycush*).
- Brook trout (*Salvelinus fontinalis*).

GRAYLINGS (THYMALLIDÆ): Montana grayling (*Thymallus montanus*).

PIKES (ESOCIDÆ): Common pickerel (*Esox lucius*).

SUNFISHES, BLACK BASSES, AND CRAPPIES (CENTRARCHIDÆ):
- Crappie (*Pomoxis annularis* and *P. sparoides*).
- Largemouth black bass (*Micropterus salmoides*).
- Smallmouth black bass (*Micropterus dolomieu*).
- Rock bass (*Ambloplites rupestris*).
- Warmouth bass, goggle-eye (*Chaenobryttus gulosus*).
- Green sunfish (*Apomotis cyanellus*).
- Bluegill sunfish (*Lepomis incisor*).
- Common sunfish (*Eupomotis gibbosus*).
- Rio Grande perch (*Herichthys cyanoguttatus*).

PERCHES (PERCIDÆ):
- Pike perch (*Stizostedion vitreum*).
- Yellow perch, ringed perch (*Perca flavescens*).

STRIPED BASSES (SERRANIDÆ): White bass (*Roccus chrysops*).

DRUMS (SCIANIDÆ): Fresh-water drum, lake sheepshead (*Aplodinotus grunniens*).

CODS (GADIDÆ):
- Cod (*Gadus callarias*).
- Haddock (*Melanogrammus æglefinus*).
- Pollock (*Pollachius virens*).

FLOUNDERS (PLEURONECTIDÆ): Winter flounder, American flatfish (*Pseudopleuronectes americanus*).

MACKEREL (SCOMBRIDÆ): Common mackerel (*Scomber scombrus*).

OUTPUT

The division has been able to exceed all former records of the distribution of fish and eggs by a total of 500,000,000. It is probable that the feature of greatest popular interest in considering this total, is the fact that over 205,000,000 of the forms distributed belong to the game species and represent about 2.7 per cent of the total, 1.7 per cent greater than the figures for 1929 and identical with those for 1928. The marine species, including eggs and fry, account for the major portion of the huge total with a percentage of 85.9. Six and nine-tenths per cent comprise species of the interior waters which, in addition to supporting market fisheries, are likewise sought to a considerable extent by sportsmen, particularly in the case of the pike perch, lake or Mackinaw trout, and yellow perch. Commercial anadromous forms comprise 4 per cent of the total. The above ratios are substantially the same as those which have existed during the past few years, indicating that the numerical increases in output are distributed quite equitably among the various fields of activity. After a drop during the previous year, the fingerling production was again raised to a point above 250,000,000. This is sufficient to include virtually all the game fishes and large numbers of other forms, particularly the Pacific salmons, which are amenable to artificial feeding and rearing in nursery or hatchery ponds.

Summary, by species, of the output of fish and fish eggs during the fiscal year ended June 30, 1930

Species	Eggs	Fry	Fingerlings	Total
Catfish			86,422,900	86,422,900
Buffalofish	35,613,000		1,376,300	36,989,300
Common sucker	6,750,000			6,750,000
Carp	95,375,000	2,600,000	4,388,100	102,363,100
Shad		4,813,000		4,813,000
Glut herring		10,000,000		10,000,000
Whitefish	6,450,000	146,815,000		153,265,000
Cisco		33,950,000		33,950,000
Chinook salmon	2,310,000	1,585,000	20,971,200	24,866,200
Chum salmon	250,000	23,791,000	403,000	24,444,000
Silver salmon	828,000	4,838,000	2,091,000	7,757,000
Sockeye salmon	4,667,000	6,430,000	20,182,300	31,279,300
Humpback salmon	1,021,000	5,227,000	54,400	6,302,400
Steelhead salmon	2,490,000	795,000	4,485,300	7,770,300
Atlantic salmon	755,000		106,400	861,400
Landlocked salmon	35,000	80,000	845,800	960,800
Rainbow trout	5,688,000		7,216,200	12,904,200
Golden trout			10,000	10,000
Black-spotted trout	6,818,000	55,000	9,584,100	16,457,100
Loch Leven trout	10,896,000	2,149,000	2,930,000	15,975,000
Lake trout	415,000	30,093,000	680,500	31,188,500
Brook trout	500,000	2,353,000	14,046,600	16,899,600
Grayling		1,000,000		1,000,000
Smelt	12,000,000			12,000,000
Pike and pickerel			451,000	451,000
Mackerel		16,502,000		16,502,000
Crappie			19,436,400	19,436,400
Largemouth black bass		1,280,000	1,898,400	3,178,400
Smallmouth black bass		480,000	52,500	532,500
Rock bass			94,500	94,500
Warmouth bass			34,300	34,300
Sunfish			30,499,000	30,499,000
Pike perch	24,850,000	141,515,000		166,365,000
Yellow perch	53,700,000	117,685,000	2,661,500	174,046,500
White bass			285,500	285,500
Rio Grande perch			5,800	5,800
Fresh-water drum			2,400	2,400
Cod	2,055,034,000	229,769,000		2,284,803,000
Haddock	220,344,000	36,416,000		256,760,000
Pollock		616,713,000		616,713,000
Winter flounder	6,692,000	3,329,897,000		3,336,589,000
Miscellaneous fishes			18,954,900	18,954,900
Total	2,553,481,000	4,766,831,000	250,170,300	7,570,482,300

COOPERATION WITH OTHER CONSERVATION AGENCIES

It is obvious that with the various States carrying on fish-cultural work of the magnitude indicated in the tabulations following later, there must be a considerable degree of cooperation and coordination with the Bureau of Fisheries to avoid duplication, overlapping, and waste energy. Practical methods of cooperation with these factors in mind have been and are constantly being developed throughout the country. In many cases there is a joint use of hatchery equipment to take care of the surplus fry at Federal or State hatcheries. Loaning of the bureau's equipment, such as distribution cars, or the services of its experienced men, has been a prolific source of benefit. The instances cited below are given merely as an example and do not constitute an attempt to list all of the cooperative measures that have been in effect with the States.

The bureau has continued the detail of the superintendent of its Arkansas station to supervise the construction of the new State hatchery at Lonoke. Ultimately this will be one of the largest bass hatcheries in the country. Financial aid and the assistance of the bureau's employees were rendered in connection with the efforts of the fisheries authorities of South Carolina to develop the propagation of shad in that State. The bureau assigned a much larger percentage than formerly of the Atlantic salmon eggs received from Canada to the State hatcheries in Maine, with the view of obtaining greater facilities for rearing these fish to the large fingerling size before distribution. The bureau developed joint spawn-taking operations at Pyramid Lake, Nev., taking over the work when the State was forced out. Among the hatcheries operated on a joint basis were those for pike perch on Lake Champlain and the large bass pond recently constructed at Miles City, Mont. A similar joint activity was maintained with the State of Minnesota in connection with the collection and incubation of pike-perch eggs.

High appreciation must again be expressed for the valuable aid rendered by the State of Michigan in the propagation of the commercial species of the Great Lakes. The bureau has endeavored to give further assistance to the State of Virginia in the development of its fish-cultural program by assigning fish to nursery projects. The facilities of the White Sulphur Springs (W. Va.) station have again been available to the State of West Virginia for hatching fish for rearing at its various field stations. Much of the success attained on the Pacific coast is due to close contact and ready assistance available from the States of Oregon and Washington. A clearer picture of the assistance the bureau has been able to render in the assignment of eggs will follow in a table showing the shipment of eggs to the various States.

The activities of the division of fish culture impinge to a certain extent upon the work of practically all of the other Federal conservation agencies. Contact with the National Park Service is based on the bureau's operation of hatcheries exclusively for the restocking of national park waters. The extensive demand for trout and other species for maintaining good fishing in those other extensive recreation areas, the national forests, necessitates a close liaison with the Forest Service. A conference was held with representatives of that

agency during the year and a definite program outlining stocking requirements in the national forests throughout the country was submitted to the bureau. The growing importance of irrigation reservoirs and similar reclamation projects, both as fishing areas and as field stations for the collection of eggs from wild fish, brings the bureau in increasingly close contact with the Reclamation Service. The new fish-cultural plant which has been under construction during the past two years at Yellowstone Park will be ready for operation shortly after the close of the fiscal year. The bureau has appointed a district supervisor for the Rocky Mountain region and the greater part of his duties will be to work with national forest and national park officers in the improvement of fishing conditions in those areas.

COOPERATIVE FISH NURSERIES

The cooperative fish-rearing program contemplates the unification of the efforts of the bureau and private sportsmen's organizations in the production of larger fish, and has now been developed to the point where it is one of the routine activities of the division. It has been amply demonstrated that sportsmen's groups can take small fish from the Federal hatcheries and rear them to large fingerling or legal size in nursery pools or ponds constructed, maintained, and operated by themselves, with a reasonable degree of success. The overcrowding of the bureau's facilities at the hatcheries is largely overcome by this means, and the sportsmen are in position to determine by their own efforts the size to which fish are to be reared before planting in their streams.

At the outset the program was developed with the provision that the bureau retain 50 per cent of the output of these nurseries for meeting its own applications. While this provision is still retained in the agreement with the sportmen's groups, in practically no case has the bureau exercised its rights. The total of 125 nurseries in operation this year represents only a limited increase over last year's list. The assignment of fish, slightly in excess of 4,000,000, represents a decrease of almost 1,000,000 below the numbers furnished during 1929. The decline is largely accounted for by the cessation of trout work at the Harrisburg (Pa.) cooperative hatchery, which utilized over 350,000 fish and eggs during the previous year, and a reduction from 800,000 to 245,000 in the number of lake-trout fry reared at the Rogers City nursery in Michigan. The bureau is also exercising greater care in passing on the requests of the nursery sponsors for increased assignments since in many cases the granting of larger allotments would overstock the available facilities and jeopardize the entire output.

In view of the fact that the demands for fish nurseries are straining the bureau's resources, greater care is also exercised in scrutinizing the sites for new nurseries, thereby making the annual increment considerably less than was the case during the first two or three years of development. Fully as many nursery sites have been rejected, due to unsuitable conditions, as have been accepted during the year. A glance at the following table shows that a majority of the establishments are grouped in three States in which the work

has been particularly successful. It is hoped that further expansion will be in the direction of additional nurseries in new territory and in the nature of more bass nurseries, the demand for which is pressing. The securing of a proper site for a bass nursery is more difficult, however, and its development may involve considerable expense, although the actual maintenance is much lower than is the case with trout.

At the close of the year unprecedented drought conditions in a few sections were causing concern as to the permanence of the water supply. Reports of fishing in locations where the nurseries have been in operation for two or more years have shown that the work is reflected in much more satisfactory angling conditions. The output of many of the State hatcheries is allotted likewise to rearing pools supervised by the State officials with equally satisfactory results.

Cooperative nurseries and rearing ponds supervised by the bureau in 1930

Locality	Number of fish supplied	Kind
Massachusetts:		
Lowell	10,000	Brook trout.
Pittsfield	27,500	Do.
Michigan:		
Clare	115,000	Do.
Highland	10,000	Do.
Turtle Lake	186,000	Do.
Do	4,500	Landlocked salmon.
Rogers City	245,000	Lake trout.
Minnesota:		
Anoka	5,000	Brook trout.
Kimball	6,500	Do.
Lake City	20,000	Do.
Mora	6,000	Do.
Northfield	5,000	Rainbow trout.
Red Wing	16,000	Loch Leven trout.
Rochester	90,000	Rainbow trout.
Hokah	5,000	Brook trout.
Rushford	20,000	Rainbow trout.
St. Charles	15,000	Do.
Wadena	5,000	Brook trout.
Winona	20,000	Loch Leven trout.
Do	20,000	Do.
Do	15,000	Do.
Do	5,000	Brook trout.
Do	20,000	Do.
Do	3,000	Do.
Missouri: Joplin	34,000	Black bass.
New Hampshire:		
Claremont	5,000	Brook trout.
Dublin	15,000	Do.
Greenville	10,000	Do.
Hocksett	10,000	Do.
Lebanon	20,000	Do.
Merrimack	10,000	Do.
Peterboro	10,000	Do.
Wilton	10,000	Do.
New Jersey: Paterson	10,000	Do.
New York:		
Adams	10,000	Do.
Arena	10,000	Loch Leven trout.
Austerlitz	4,000	Brook trout.
Barneveld	273,962	Do.
Do	88,620	Rainbow trout.
Do	148,230	Brook trout eggs.
Do	75,000	Rainbow trout eggs.
Do	30,000	Loch Leven trout eggs.
Malone	71,000	Brook trout.
Do	15,000	Loch Leven trout.
Oneonta	105,000	Brook trout.
Do	12,000	Loch Leven trout.
Watertown	110,000	Brook trout.

Cooperative nurseries and rearing ponds supervised by the bureau in 1930—Continued

Locality	Number of fish supplied	Kind
Pennsylvania:		
Altoona	15,000	Brook trout.
Do	15,300	Rainbow trout.
Do	10,000	Loch Leven trout.
Analomink	10,000	Do.
Bellefonte	25,000	Brook trout.
Belleville	19,800	Rainbow trout.
Berwick	20,000	Brook trout.
Bloomsburg	30,000	Do.
Do	10,000	Loch Leven trout.
Boswell	5,000	Brook trout.
Carrolltown	15,000	Loch Leven trout.
Chambersburg	15,000	Brook trout.
Do	15,300	Rainbow trout
Chester	10,000	Do.
Do	10,000	Loch Leven trout.
Clearfield	25,000	Brook trout.
Connellsville	10,000	Do.
Ebensburg	10,000	Do.
Fairmont Springs	15,000	Do.
Galeton	40,200	Do.
Hazleton	10,000	Do.
Do	10,000	Rainbow trout.
Johnsonburg	10,000	Brook trout.
Johnstown	10,500	Do.
Do	9,900	Rainbow trout.
Ligonier	25,200	Brook trout.
Do	24,900	Rainbow trout.
Monaca	50	Black bass.
Muncy	35,000	Brook trout.
Do	25,250	Do.
Do	20,000	Loch Leven trout.
Myersdale	30,000	Brook trout.
Pittston	10,000	Do.
Do	5,000	Loch Leven trout.
Punxsutawney	10,000	Brook trout.
Renovo	40,000	Do.
Ridgway	15,000	Rainbow trout.
Scranton	60,000	Brook trout.
Somerset	25,000	Do.
Do	15,000	Rainbow trout.
Troy	10,000	Brook trout.
Williamsport	20,000	Do.
Do	15,000	Do.
Do	30,000	Loch Leven trout.
Do	50,000	Brook trout.
Windber	360,000	Brook trout eggs.
Vermont:		
Bennington	50,000	Brook trout.
Norton Mills	82,800	Do.
Do	25,000	Lake trout.
Do	40,000	Landlocked salmon.
Virginia:		
Big Stone Gap	20,000	Rainbow trout.
Charlottesville	25	Smallmouth black bass.
Shawsville	15,000	Rainbow trout.
West Virginia:		
Durbin	25,200	Brook trout.
Do	5,000	Rainbow trout.
Wisconsin:		
Altoona	5,000	Do.
Arcadia	15,000	Brook trout.
Athelstane	25,000	Do.
Bay City	5,000	Do.
Black River Falls	12,800	Do.
Boyd	5,000	Do.
Cumberland	9,000	Do.
Darlington	10,000	Loch Leven trout.
Eau Claire	17,500	Rainbow trout.
Do	2,500	Brook trout.
Do	30,000	Rainbow trout.
Ellsworth	36,500	Brook trout.
Do	13,500	Rainbow trout.
Elmwood	3,000	Brook trout.
El Paso	15,000	Do.
Elroy	3,000	Do.
Galesville	20,000	Do.
Gilmanton	5,000	Do.
Goodman	8,000	Do.
Hatley	10,000	Do.
Hazel Green	10,000	Do.
Holmen	8,000	Do.

Cooperative nurseries and rearing ponds supervised by the bureau in 1930—Continued

Locality	Number of fish supplied	Kind
Wisconsin—Continued.		
Independence	17,500	Brook trout.
La Crosse	10,000	Do.
Do	10,000	Loch Leven trout.
Do	11,000	Brook trout.
Laona	27,000	Do.
Madison	10,000	Do.
Do	10,000	Rainbow trout.
Manitowoc	10,000	Do.
Marathon	20,000	Brook trout.
Medford	2,100	Do.
Merrill	18,000	Do.
Monroe	15,000	Do.
Mountain	20,000	Do.
Nekoosa	19,000	Do.
Osseo	6,000	Do.
Park Falls	11,400	Do.
Plum City	6,000	Do.
Do	4,000	Rainbow trout.
Prescott	15,000	Brook trout.
Rothschild	16,200	Do.
Schofield	6,000	Do.
Shullsburg	10,000	Loch Leven trout.
Stanley	20,000	Brook trout.
Stevens Point	20,000	Do.
Do	10,000	Rainbow trout.
Tomahawk	20,000	Brook trout.
Tunnel City	10,000	Do.
Viola	5,000	Rainbow trout.
Viroqua	6,000	Do.
Wausau	16,000	Brook trout.
Do	8,000	Loch Leven trout.
Total	3,883,737	

STATE FISH-CULTURAL ACTIVITIES

Following the plan initiated in 1929, the bureau has again endeavored to collect data on the fish-cultural activities of the States by means of questionnaires. The following tables present this information:

Data on State fish-cultural activities and licenses

State	Number of fishing licenses issued	Fees received from licenses	Number of hatcheries	Number of fish-cultural employees	Expenditures for propagation of fish
Alabama	444	$2,200.00	1	2	$8,430.52
Arizona	34,462	94,844.75	3	5	15,688.95
Arkansas	26,400	62,000.00	1	2	35,000.00
California	229,374	469,442.00	26	115	292,000.00
Colorado	114,538	210,382.75	14	28	65,132.78
Connecticut	42,792	102,874.50	7	12	68,050.74
Delaware	4,334	10,026.50			500.00
Florida	24,602	71,218.30	7	12	41,596.70
Georgia			1	2	6,859.24
Idaho	93,547	200,000.00	11	14	70,000.00
Illinois	385,127	170,455.52	6	6	
Indiana	320,674	307,444.20	5	15	63,998.18
Iowa	175,000	175,000.00	4	6	38,819.83
Kansas	81,299	81,299.00	3	11	38,000.00
Kentucky	60,184		3	8	8,518.36
Louisiana	30,000	30,341.22	3	5	5,520.00
Maine	68,384	97,079.50	12	36	86,182.32
Maryland	14,314	16,525.32	6	2	40,395.62
Massachusetts	121,476	285,383.00	7	11	56,115.18
Michigan	134,965	260,733.00	17	15	400,000.00
Minnesota	397,257	366,418.63	12	29	100,340.09
Missouri	308,689	411,876.00	8	20	45,545.00
Montana	85,878	184,644.00	14	18	68,167.00
Nebraska	173,408	176,572.00	4	18	100,000.00

Data on State fish-cultural activities and licenses—Continued

State	Number of fishing licenses issued	Fees received from licenses	Number of hatcheries	Number of fish-cultural employees	Expenditures for propagation of fish
Nevada	6,748	$ 10,462.00	3	4	$ 13,500.00
New Hampshire	74,526	130,780.35	6	17	76,972.17
New Mexico	16,925	137,477.00	6	10	46,566.76
New Jersey	200,052	295,228.35	2	15	86,284.53
New York	607,724	661,891.11	11	164	287,713.69
North Carolina	29,000	45,527.35	5	9	50,000.00
North Dakota	3,429	1,714.50	3	3	5,420.00
Ohio	90,000	92,123.00	15	50	109,662.00
Oklahoma	81,000	81,000.00	5	18	100,000.00
Oregon	78,750	270,345.50	39	135	255,717.18
Pennsylvania	263,633	395,450.00	8	36	192,158.39
Rhode Island	13,438	15,804.10	2	6	22,449.10
South Carolina	1,084	3,252.00			
South Dakota	112,209	119,283.00	6	8	43,376.93
Tennessee					
Texas	32,111	32,111.00	7	35	106,000.00
Utah	60,000	150,000.00	8	12	64,000.00
Vermont	60,530	86,859.75	5	15	42,914.92
Virginia	144,215	249,373.50	4	5	30,000.00
Washington	212,790	402,591.50	27	49	151,076.37
West Virginia	189,000	70,000.00	1	6	20,000.00
Wisconsin	85,035	225,566.18	23	33	183,174.00
Wyoming	28,757	51,327.75	8	14	82,000.00
Total	5,318,104	7,314,928.13	369	1,096	3,624,046.55

Output of fish by State hatcheries

State	Trout	Bass	Other game fish	Commercial species	Total
Alabama		17,085	146,000		163,085
Arizona	3,036,400	5,000	31,000		3,072,400
Arkansas		500,000			500,000
California	35,152,075	3,545	65,379	6,269,365	41,490,364
Colorado	27,000,000				27,000,000
Connecticut	618,939	1,634	365,715	206,163,000	207,149,288
Delaware		10,000	7,000		17,000
Florida		1,444,200	200,000	[1] 103,292,000	105,036,200
Georgia	600,000				600,000
Idaho	10,000,000		30,000		10,030,000
Indiana		714,360	8,491,350		9,205,710
Iowa	330,124	8,120	55,000,000		55,338,244
Kansas		200,000	550,000		750,000
Kentucky		53,814			53,814
Louisiana		221,301	258,000		479,301
Maine	5,000,000	3,000	2,000,000		7,003,000
Maryland	200,645	57,860	600	841,999,600	842,258,705
Massachusetts	580,736	286,406	721,339		1,588,481
Michigan	16,443,642	742,639	70,883,730	133,640,900	221,710,911
Minnesota	5,844,070	168,364		468,876,899	474,889,333
Missouri	368,386	262,699	331,283		962,368
Montana	26,401,334	284,350	10,646,200	999,000	38,330,884
Nebraska	415,230	314,384	1,371,765		2,101,379
Nevada	1,142,750				1,142,750
New Hampshire	4,365,287		259,920	75,000,000	79,625,207
New Mexico [2]	3,603,440	14,000	21,500		3,638,940
New Jersey	650,182	131,000		95,105,450	95,886,632
New York	10,540,725	548,800	93,263,835	932,572,230	1,036,925,590
North Carolina	3,760,000	150,000			3,910,000
North Dakota				15,000,000	15,000,000
Ohio		181,400	1,174,604	190,000,000	191,356,004
Oklahoma		924,120	155,750		1,079,870
Oregon	22,943,397	491,400	2,351,031	92,912,047	118,697,875
Pennsylvania	749,551	255,905	283,521,028	114,430,000	398,956,484
Rhode Island	22,764	19,000			41,764
South Dakota	1,367,765	43,550	5,275,967	96,735	6,784,017
Texas		873,000	347,250		1,220,250
Utah	11,000,000				11,000,000
Vermont	1,800,000	13,275		23,700,087	25,513,362
Virginia	15,000	700	25,000,000		25,015,700
Washington	28,936,067			137,478,714	166,414,781
West Virginia	986,500	22,500			1,009,000
Wisconsin	9,411,855	205,731	302,559,970	30,607,000	342,784,556
Wyoming	8,500,000				8,500,000
Total	241,786,864	9,173,142	865,030,216	3,468,243,027	4,584,233,249

[1] Crayfish (102,660,000)

[2] Data cover 18 months' period.

In consulting these data, recognition should be given to several important considerations. Owing to the fact that the various States do not utilize identical calendar periods for their fiscal years, the figures cited do not cover a specific period but comprise the output for the latest fiscal year for which complete data are available. The period covered may be a fiscal year ending June 30 or at some other date, or it may represent the calendar year ending December 31, 1929. The reports, therefore, are approximate and cover an average aggregate output for the entire country.

Furthermore, direct comparison of the numerical output of the different States should not be made without a clear realization of the fish distribution practices followed. In many of the Eastern States, such as Pennsylvania, Massachusetts, Connecticut, New Jersey, etc., the total output of trout and bass may appear to be limited in comparison with other States. This is due to the fact that the State policy is to distribute large-sized fish approaching legal size; and the above-mentioned States, together with others, may be among the foremost in conservation work and universally recognized as providing excellent angling by virtue of the above-mentioned distribution policy. The figures, therefore, are more useful to enable a comparison of each State's production in contrast to its own efforts in previous years rather than for comparison as between States on a competitive basis.

The aggregate production of 4,584,233,249 represents an increase of over 500,000,000 above the total for last year. The increase appears largely in the output of commercial species, the production of trout having declined from 255,050,612 to 241,786,864. Owing to a different method of tabulation the output of bass can not be compared with that of the previous year. In classifying the various groups, the bureau accepted the allocations to the heads "commercial species" and "other game fishes," as made by the States themselves. For example, in the Great Lakes States the wall-eyed pike may be classified in the former group, while in other States it is considered a game fish. Similar conditions exist with regard to many other species, and the same variety may be listed under either of the two above headings but there will, of course, be no duplication. It is felt that the opinions of the State authorities and the fishermen themselves should determine the group in which any given species should be included rather than any arbitrary conclusion by the bureau.

In view of the very general practice of lumping fishing and hunting licenses together, for residents at least, under the heading of a combination license, it is manifestly impossible to secure definite figures on the actual number of licensed anglers. Data on the issuance of fishing licenses, therefore, cover all classes of licenses which carry, individually or in combination, the privilege of fishing. Not all individuals who took out these licenses did so for the purpose of angling. At the same time, there is a very large number of sport fishermen in many States who are not required to possess a license. Landowners and members of their families constitute a very large group in this category. In some States licenses are required only for angling with artificial lures. The figure 5,318,104, therefore, represents the number of potential anglers only, and has no definite value otherwise. In view of the large numbers exempted from the

requirements for license, the actual number of individuals who go fishing is probably considerably in excess of the figure cited. No license data were collected in 1929, therefore, no comparisons are practicable.

The number of hatcheries is 10 greater than was reported last year, and there is an unexplained increase of over 300 employees above the incomplete records obtained in 1929.

Expenditures for the propagation of fish show an increase of almost $1,000,000 in comparison with the previous year. It will be noted that the income from licenses is practically double the amount expended on the propagation of fish. As stated above, however, much of the value attributed to licenses accrues from the hunters, and there is no reason to believe that the anglers are suffering any discrimination when only 50 per cent of the license income is allotted to the rearing and distribution of fish.

The entire summary presents a very encouraging picture of the progress of conservation of fish life by State agencies in the fields of artificial propagation.

SALVAGE OF FOOD FISHES

Weather conditions and rainfall in the upper Mississippi River territory were normal in so far as water levels and consequent necessity for rescue operations were concerned. The result was a season involving the salvage of over 161,000,000 fish, in spite of the fact that activities closed somewhat earlier than usual. Approximately three-tenths of 1 per cent of all fish handled in connection with this activity were distributed to applicants or transferred to waters other than those to which the fish may be considered native. Strict adherence to this policy of minimizing distant shipments of salvaged fish is responsible for the bureau's refusal to furnish many organizations or individuals with carload or full-messenger shipments. The ultimate purpose of the bureau is to produce sufficient fish in seminatural rearing ponds of the Upper Mississippi River Wild Life Refuge and at its new hatcheries to obviate the necessity of removing any fish whatever from the rescue territory.

Number and disposition of fish rescued, fiscal year 1930

Locality and species	Delivered to applicants	Restored to original waters	Total number of fish rescued
All stations:			
Buffalofish	10	1,355,839	1,355,849
Carp		4,388,085	4,388,085
Catfish	59,467	86,256,326	86,315,793
Crappie	64,120	18,792,440	18,856,560
Fresh-water drum		2,357	2,357
Largemouth black bass	180,617	411,271	591,888
Pike and pickerel	626	449,995	450,621
Rock bass	150		150
Sunfish	175,052	28,877,233	29,052,285
White bass	225	284,516	284,741
Yellow perch	42,030	2,602,082	2,644,112
Miscellaneous	5,088	17,407,080	17,412,168
Total	527,385	160,827,224	161,354,609
Summary, by stations:			
Andalusia, Ill		9,432,385	9,432,385
Bellevue, Iowa	37,088	35,662,189	35,699,277
Friar Point, Miss	36,465	5,757,020	5,793,485
Homer, Minn	183,325	22,042,470	22,225,795
La Crosse, Wis	73,870	20,693,380	20,767,250
Lynxville, Wis	61,904	40,539,260	40,601,164
Marquette, Iowa	134,733	26,700,520	26,835,253
Total	527,385	160,827,224	161,354,609

TRANSFERS OF EGGS BETWEEN STATIONS

The following table indicates the extent to which a limited number of stations are called upon to supply eggs for a majority of the bureau's game-fish hatcheries. Some of these establishments are particularly adapted for the propagation of certain species of trout, and it is much more economical to operate them largely as egg-producing units for the stocking of other hatcheries from which actual distribution of the young fish is made. It is also advisable to make frequent interchanges of eggs between stations for the purpose of introducing new blood and new strains into the brood stock at the various hatcheries.

Transfer of eggs between stations, fiscal year 1930

Species	Number of eggs	From—	To—
Atlantic salmon	125,000	Craig Brook, Me	Grand Lake Stream, Me.
Black-spotted trout	753,000	Yellowstone Park, Wyo	Bozeman, Mont.
	793,000	do	Glacier Park, Mont.
	150,000	do	Leadville, Colo.
	200,000	do	Saratoga, Wyo.
	100,000	do	Seattle, Wash.
	95,000	do	Springville, Utah.
Brook trout	250,000	Berkshire, Mass	Cape Vincent, N. Y.
	400,000	Craig Brook, Me	Erwin, Tenn.
	100,000	do	Green Lake, Me.
	75,000	do	Nashua, N. H.
	400,000	do	Wytheville, Va.
	1,100,000	York Pond, N. H	St. Johnsbury, Vt.
	150,000	do	Barneveld, N. Y.
	700,000	do	La Crosse, Wis.
	450,000	do	Nashua, N. H.
	600,000	do	Northville, Mich.
	132,000	Springville, Utah	Bozeman, Mont.
	500,000	do	Saratoga, Wyo.
	252,000	do	Seattle, Wash.
Chinook salmon	600,000	Battle Creek, Calif	Mill Creek, Calif.
	550,000	Big White Salmon, Wash	Clackamas, Oreg.
	1,242,000	Little White Salmon, Wash	Puget Sound stations.
	10,000	Birdsview, Wash	Central station, Washington, D. C.
Chum salmon	250,000	Quilcene, Wash	Springville, Utah.
Cisco	1,000,000	Cape Vincent, N. Y	Central station, Washington, D. C.
Landlocked salmon	10,000	Craig Brook, Me	Northville, Mich.
	200,000	Green Lake, Me	Craig Brook, Me.
Loch Leven trout	236,000	Bozeman, Mont	Cape Vincent, N. Y.
	250,000	do	Crawford, Nebr.
	400,000	do	La Crosse, Wis.
	175,000	do	Spearfish, S. Dak.
	374,000	do	Springville, Utah.
	375,000	do	White Sulphur Springs, W. Va.
	10,256,200	Meadow Creek, Mont	Bozeman, Mont.
Pike perch	2,100,000	Swanton, Vt	Central station, Washington, D. C.
Rainbow trout	247,000	Lost Creek, Wyo	Saratoga, Wyo.
	680,200	Meadow Creek, Mont	Bozeman, Mont.
	975,100	do	Glacier Park, Mont.
	50,000	Salmon, Idaho	Leadville, Colo.
	110,800	Creede, Colo	Do.
	294,300	Manchester, Iowa	La Crosse, Wis.
	75,000	Neosho, Mo	Northville, Mich.
	26,000	do	White Sulphur Springs, W. Va.
	75,000	Bourbon, Mo	Barneveld, N. Y.
	550,000	do	Bozeman, Mont.
	25,000	do	Erwin, Tenn.
	100,000	do	Spearfish, S. Dak.
	185,540	Spearfish, S. Dak	Crawford, Nebr.
Silver salmon	123,320	Quinault, Wash	Birdsview, Wash.
	1,469,664	do	Quilcene, Wash.
	515,000	Baker Lake, Wash	Bridsview, Wash.
Sockeye salmon	100,000	do	Do.
	100,000	Quinault, Wash	Clackamas, Oreg.
	1,000	do	Birdsview, Wash.
	1,028,400	do	Quilcene, Wash.
Steelhead salmon	27,000	Birdsview, Wash	Charlevoix, Mich.
	26,000	do	St. Johnsbury, Vt.
	69,000	Quilcene, Wash	Birdsview, Wash.
	138,000	Sultan, Wash	Do.
	100,000	Applegate Creek, Oreg	Creede, Colo.
	50,000	do	Clackamas, Oreg.
	176,000	do	Rogue River, Oreg.
	50,000	do	St. Johnsbury, Vt.

Assignments of fish eggs to State and Territorial fish commissions, fiscal year 1930

State and species	Number	State and species	Number
California:		New Hampshire: Chinook salmon	75,000
Atlantic salmon	20,000	New Mexico: Loch Leven trout	2,504,000
Loch Leven trout	50,000	New York:	
Steelhead salmon	200,000	Lake trout	240,000
Colorado:		Landlocked salmon	120,000
Lake trout	100,000	North Carolina:	
Loch Leven trout	1,125,000	Loch Leven trout	150,000
Rainbow trout	100,000	Rainbow trout	100,000
Steelhead salmon	350,000	Oregon:	
Connecticut: Loch Leven trout	200,000	Sockeye salmon	4,553,200
Georgia: Rainbow trout	476,000	Steelhead salmon	1,217,000
Hawaii:		Pennsylvania:	
Chinook salmon	25,000	Atlantic salmon	20,000
Steelhead salmon	50,000	Brook trout	400,000
Idaho:		Common sucker	6,750,000
Steelhead salmon	300,000	Pike perch	24,900,000
Whitefish	1,000,000	Rainbow trout	100,000
Maine: Atlantic salmon	535,000	South Dakota: Loch Leven trout	300,000
Maryland:		Utah:	
Loch Leven trout	200,000	Loch Leven trout	270,000
Rainbow trout	200,000	Silver salmon	526,126
Massachusetts: Loch Leven trout	100,000	Vermont:	
Michigan:		Lake trout	25,000
Landlocked salmon	10,000	Landlocked salmon	5,000
Steelhead salmon	50,000	Washington:	
Whitefish	3,200,000	Black-spotted trout	1,525,000
Minnesota: Loch Leven trout	100,000	Humpback salmon	1,021,000
Montana:		Wyoming:	
Loch Leven trout	4,100,000	Black-spotted trout	2,302,000
Rainbow trout	1,112,000	Loch Leven trout	2,125,000
Nevada:		Rainbow trout	308,500
Brook trout	20,000		
Rainbow trout	796,000	Total	63,955,826

SHIPMENTS TO FOREIGN COUNTRIES

The forwarding of less than 2,500,000 trout eggs to four foreign countries during the year represents a decline in this activity. Shipments of eggs to Canada are involved in a transfer arrangement whereby the bureau receives Atlantic salmon eggs. Of especial interest was the shipment of eggs to Chile, which was accompanied by the chief inspector of fisheries of that Government upon his return from an official visit to this country. These shipments are the nucleus of a carefully considered effort to acclimatize desirable food and game fishes from the United States in Chilean waters.

Shipments of fish eggs to foreign countries, fiscal year 1930

Country and species	Number of eggs	Country and species	Number of eggs
Canada:		Chile—Continued.	
Black-spotted trout	500,000	Sockeye salmon	114,000
Loch Leven trout	300,000	Whitefish	250,000
Rainbow trout	500,000	Ecuador: Rainbow trout	100,000
Chile:		Venezuela: Steelhead salmon	100,000
Chinook salmon	200,000		
Lake trout	200,000	Total	2,489,040
Silver salmon	225,040		

OUTPUT OF STATIONS AND SUBSTATIONS

The distributions previously mentioned are obtained from the operation of 37 stations and 48 substations and auxiliaries, some of which are of a purely temporary nature. The latter are operated

for the collection of eggs for short periods during the year. The number of main stations remained the same as in 1929, but there was an increase of eight substations. The hope of increased production in the future rests largely upon the opening of new field and auxiliary stations, since the larger hatcheries are developed to the point of maximum capacity.

Stations and substations operated and output of each, fiscal year 1930

[Asterisk (*) denotes transfer of eggs. See table, p. 1136]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total [1]
Afognak, Alaska: Sockeye salmon	4, 553, 200		8, 620, 000	13, 173, 200
Baird, Calif.: Chinook salmon			1, 951, 000	1, 951, 000
Battle Creek, Calif.: Chinook salmon	*1, 500, 000		5, 187, 000	6, 687, 000
Mill Creek, Calif.: Chinook salmon			2, 883, 500	2, 883, 500
Baker Lake, Wash.:				
Silver salmon	(*)			
Sockeye salmon	(*)		1, 160, 000	1, 160, 000
Birdsview, Wash.—				
Brook trout			5, 400	5, 400
Chinook salmon	* 225, 000	1, 427. 000	1. 208, 000	2, 860, 000
Humpback salmon		3, 010, 000	29, 900	3, 039, 900
Silver salmon	132, 000	2, 320. 000	276. 500	2, 728, 500
Sockeye salmon			64, 175	64, 175
Steelhead salmon	* 535, 000	462, 000	1, 244, 000	2, 241, 000
Duckabush, Wash.—				
Chinook salmon			290, 000	290, 000
Chum salmon		14, 171, 000		14, 171, 000
Humpback salmon		713, 500	24, 500	738, 000
Silver salmon		512, 000	303, 700	815, 700
Steelhead salmon			206, 000	206, 000
Lake Crescent, Wash.—				
Sockeye salmon			1, 672, 075	1, 672, 075
Quilcene, Wash.—				
Chinook salmon		50. 000	241, 500	291, 500
Chum salmon	* 250, 000	9, 620. 000		9, 870, 000
Humpback salmon		110, 000		110, 000
Silver salmon		1, 235, 000	297, 000	1, 532, 000
Steelhead salmon	* 137, 500		431, 000	568, 500
Sultan, Wash.—				
Chinook salmon			47, 400	47, 400
Humpback salmon		4, 400		4, 400
Silver salmon		337, 700	163, 800	501, 500
Steelhead salmon	(*)	317, 260	114, 000	431, 260
Berkshire trout hatchery, Mass.:				
Brook trout	(*)		318, 040	318, 040
Catfish			400	400
Pickerel			400	400
Rainbow trout			15, 795	15, 795
Boothbay Harbor, Me.:				
Cod	1, 661, 893, 000			1, 661, 893, 000
Haddock	124, 920, 000			124, 920, 000
Winter flounder		2, 434, 538, 000		2. 434, 538, 000
Bozeman, Mont.:				
Black-spotted trout	132, 000		1, 269, 200	1, 401, 200
Brook trout			[2] 519, 255	519, 255
Golden trout			10, 000	10. 000
Loch Leven trout	*8, 819. 600		178, 740	8, 998, 340
Rainbow trout	350, 100		828, 610	1, 178, 610
Glacier Park, Mont.—				
Black-spotted trout	231, 000		872, 650	1, 103, 650
Rainbow trout			391, 700	391, 700
Meadow Creek, Mont.—				
Black-spotted trout		30, 000	515. 500	545, 500
Grayling		1, 100, 000		1, 100, 000
Loch Leven trout	*2, 076, 500	2, 116, 200	1, 560, 000	5, 752, 700
Rainbow trout	*700, 200		1, 183, 400	1, 883, 600
Miles City, Mont.—				
Largemouth black bass			87, 550	87, 550
Crappie			142, 550	142, 550
Sunfish			11, 575	11, 575
Yellow perch			100	100
Cape Vincent, N. Y.:				
Brook trout		303, 500		303, 500
Cisco	(*)	27, 850, 000		27, 850, 000
Lake trout	3, 000	1, 208, 000		1, 211, 000

[1] Lost in transit, 86,925.
[2] 25,000 turned over to the State of Wyoming in cooperative work of this amount.

Stations and substations operated and output of each, fiscal year 1930—Contd.

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total [1]
Cape Vincent, N. Y.—Continued.				
Loch Leven trout		33,000		33,000
Pike perch		2,000,000		2,000,000
Whitefish		580,000		580,000
Yellow perch		2,200,000		2,200,000
Barneveld, N. Y.: Rainbow trout			57,220	57,220
Swanton, Vt—				
Common sucker	6,750,000			6,750,000
Pike perch	24,850,000	15,500,000		40,350,000
Yellow perch	53,700,000	31,880,000		85,580,000
Watertown, N. Y.—				
Brook trout			579,335	579,335
Loch Leven trout			39,600	39,600
Central station, Washington, D. C.:				
Chinook salmon		7,500		7,500
Pike perch		1,800,000		1,800,000
Fort Humphreys, Va.—				
Largemouth black bass			1,271	1,271
Shad		2,120,000		2,120,000
Sunfish			230	230
Yellow perch		80,050,000	596	80,050,596
Lakeland, Md.—				
Largemouth black bass		159,300	9,391	168,691
Crappie			9,950	9,950
Sunfish			13,160	13,160
Ogletown, Pa.: Brook trout			29,960	29,960
Clackamas, Oreg.:				
Brook trout			10,000	10,000
Chinook salmon			1,065,000	1,065,000
Rainbow trout			150,000	150,000
Steelhead salmon			158,000	158,000
Applegate Creek, Oreg.—				
Silver salmon			170,800	170,800
Steelhead salmon	*1,817,000		[3] 1,915,000	3,732,000
Big White Salmon, Wash.—				
Black-spotted trout			95,000	95,000
Brook trout			[4] 122,000	122,000
Chinook salmon	*75,000		1,500,000	1,575,000
Rainbow trout			90,000	90,000
Silver salmon		432,000		432,000
Steelhead salmon			185,000	185,000
Little White Salmon, Wash.—				
Chinook salmon	*510,000		2,500,000	3,010,000
Chum salmon			[5] 403,000	403,000
Rogue River, Oreg.—				
Chinook salmon			1,030,000	1,030,000
Silver salmon	403,000			403,000
Sockeye salmon			[6] 56,500	56,500
Steelhead salmon			135,660	135,660
Salmon, Idaho—				
Chinook salmon			3,019,000	3,019,000
Rainbow trout	(*)		713,700	713,700
Cold Springs, Ga.:				
Largemouth black bass		182,750	243,850	426,600
Catfish			3,450	3,450
Sunfish			123,835	123,835
Valdosta, Ga.—				
Largemouth black bass			1,125	1,125
Sunfish			15,000	15,000
Warmouth bass			15,000	15,000
Craig Brook, Me.:				
Atlantic salmon	*755,000		106,400	861,400
Brook trout	(*)		1,177,387	1,177,387
Landlocked salmon	*15,000		349,200	364,200
Smelt	12,000,000			12,000,000
Grand Lake Stream, Me.—				
Brook trout			125,165	125,165
Landlocked salmon	*20,000		478,630	498,630
Duluth, Minn.:				
Brook trout			184,000	184,000
Cisco		6,100,000		6,100,000
Lake trout		6,166,000	101,000	6,267,000
Pike perch		9,715,000		9,715,000
Whitefish		3,195,000		3,195,000

[3] In addition to 230,000 turned over to the State of Oregon in cooperative work.
[4] In addition to 6,500 turned over to the State of Oregon in cooperative work.
[5] In addition to 35,000 turned over to the State of Oregon in cooperative work.
[6] In addition to 46,000 turned over to the State of Oregon in cooperative work.

Stations and substations operated and output of each, fiscal year 1930—Contd.

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Edenton, N. C.:				
Largemouth black bass		198,000	63,965	261,965
Catfish			1,000	1,000
Glut herring		10,000,000		10,000,000
Shad		2,350,000		2,350,000
Sunfish			42,450	42,450
Warmouth bass			295	295
Yellow perch		2,300,000		2,300,000
Erwin, Tenn.:				
Largemouth black bass		3,950	34,760	38,710
Brook trout			215,350	215,350
Rainbow trout	29,000		344,400	373,400
Rock bass			12,930	12,930
Sunfish			7,525	7,525
Fairport, Iowa:				
Largemouth black bass		64,000	24,540	88,540
Catfish			28,800	28,800
Crappie			380	380
Smallmouth black bass			1,980	1,980
Sunfish			78,965	78,965
Gloucester, Mass.:				
Cod	393,141,000	229,769,000		622,910,000
Haddock	95,424,000	36,416,000		131,840,000
Pollock		616,713,000		616,713,000
Winter flounder		159,972,000		159,972,000
La Crosse, Wis.:				
Largemouth black bass			21,095	21,095
Brook trout			804,600	804,600
Buffalofish			21,480	21,480
Carp			168,645	168,645
Catfish			13,346,805	13,346,805
Crappie			2,607,120	2,607,120
Fresh-water drum			1,005	1,005
Loch Leven trout			159,150	159,150
Pike and pickerel			187,115	187,115
Rainbow trout			232,450	232,450
Sunfish			1,765,430	1,765,430
White bass			137,110	137,110
Yellow perch			480,555	480,555
Miscellaneous			2,387,800	2,387,800
Andalusia, Ill.—				
Largemouth black bass			2,315	2,315
Buffalofish			172,000	172,000
Carp			279,025	279,025
Catfish			3,880,000	3,880,000
Crappie			3,927,000	3,927,000
Pike and pickerel			820	820
Sunfish			454,000	454,000
Yellow perch			125	125
Miscellaneous			717,100	717,100
Bellevue, Iowa—				
Largemouth black bass			25,397	25,397
Buffalofish	14,000,000		1,002,500	15,002,500
Carp	17,500,000		1,540,000	19,040,000
Catfish			26,885,600	26,885,600
Crappie			1,146,081	1,146,081
Fresh-water drum			580	580
Pike and pickerel			37,535	37,535
Sunfish			2,142,740	2,142,740
White bass			133,180	133,180
Yellow perch			4,162	4,162
Miscellaneous			2,697,000	2,697,000
Guttenburg, Iowa—				
Buffalofish	4,462,500			4,462,500
Carp	3,875,000			3,875,000
Harpers Ferry, Iowa—				
Buffalofish	4,200,000			4,200,000
Carp	40,000,000			40,000,00
Homer, Minn.—				
Largemouth black bass			56,447	56,447
Buffalofish			75	75
Carp			17,208	17,208
Catfish			4,615,000	4,615,000
Crappie			3,493,465	3,493,465
Pike and pickerel			38,888	38,888
Rock bass			150	150
Sunfish			7,825,706	7,825,706
White bass			3,210	3,210
Yellow perch			1,931,550	1,931,550
Miscellaneous			5,693,208	5,693,208

Stations and substations operated and output of each, fiscal year 1930—Contd.

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
La Crosse, Wis..—Continued.				
Lansing, Iowa—				
Buffalofish	12,950,000			12,950,000
Carp	34,000,000			34,000,000
Lynxville, Wis.—				
Largemouth black bass			35,722	35,722
Buffalofish			34,500	34,500
Carp			454,020	454,020
Catfish			19,580,950	19,580,950
Crappie			6,429,265	6,429,265
Pike and pickerel			42,800	42,800
Sunfish			6,630,660	6,660,660
Yellow perch			55,915	55,915
Miscellaneous			7,332,000	7,332,000
Marquette, Iowa—				
Largemouth black bass			131,768	131,768
Buffalofish			116,060	116,060
Carp			1,234,700	1,234,700
Catfish			16,782,375	16,782,375
Crappie			1,292,850	1,292,850
Fresh-water drum			400	400
Pike and pickerel			137,915	137,915
Sunfish			6,958,270	6,958,270
White bass			7,750	7,750
Yellow perch			172,615	172,615
Miscellaneous			127,525	127,525
Yellowstone, Wyo.—				
Black-spotted trout	*6,455,200	25,000	6,326,000	12,806,200
Leadville, Colo.:				
Black-spotted trout			65,800	65,800
Brook trout	*100,000		3,476,500	3,576,500
Loch Leven trout			102,000	102,000
Rainbow trout			459,500	459,500
Creede, Colo.—				
Brook trout			608,360	608,360
Rainbow trout	(*)			
Louisville, Ky.:				
Largemouth black bass		135,750	8,935	144,685
Rock bass			6,640	6,640
Smallmouth black bass		404,500	7,657	412,157
Sunfish			1,280	1,280
Mammoth Spring, Ark.:				
Largemouth black bass			209,500	209,500
Rock bass			26,800	26,800
Smallmouth black bass		58,000	35,139	93,139
Sunfish			255	255
Manchester, Iowa.:				
Brook trout			374,050	374,050
Rainbow trout	*258,500		231,950	490,450
Smallmouth black bass			1,100	1,100
Nashua, N. H.:				
Brook trout			286,965	286,965
Catfish			57	57
Landlocked salmon			16,950	16,950
Rainbow trout			[7] 13,803	13,803
Smallmouth black bass		17,600		17,600
Neosho, Mo.:				
Largemouth black bass		54,200	40,335	94,535
Crappie			2,800	2,800
Rainbow trout	*868,000		[8] 101,780	969,780
Rock bass			17,876	17,876
Sunfish			4,326	4,326
Bourbon, Mo.: Rainbow trout	*1,650,000			1,650,000
Langdon, Kans.—				
Largemouth black bass			82,077	82,077
Catfish			26,295	26,295
Crappie			14,885	14,885
Rock bass			2,800	2,800
Sunfish			57,170	57,170
Northville, Mich.:				
Brook trout			849,500	849,500
Rainbow trout			221,700	221,700
Smallmouth black bass			6,200	6,200

[7] In addition to 10,413 turned over to the State of Massachusetts in cooperative work.
[8] In addition to 42,200 turned over to the State of Missouri in cooperative work.

Stations and substations operated and output of each, fiscal year 1930—Contd.

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Northville, Mich.—Continued.				
Alpena, Mich.—				
Lake trout	12,000	2,278,500	554,500	2,835,000
Pike perch		4,500,000		4,500,000
Whitefish	2,000,000	20,500,000		22,500,000
Charlevoix, Mich.—				
Lake trout	400,000	[9] 20,450,000		20,850,000
Whitefish	3,200,000	[10] 59,800,000		63,000,000
Orangeburg, S. C.:				
Largemouth black bass		127,000	196,455	323,455
Catfish			505	505
Crappie			5,225	5,225
Sunfish			39,890	39,890
Warmouth bass			4,860	4,860
Georgetown, S. C.: Shad		40,000		40,000
Jacksonboro, S. C.: Shad		423,500		423,500
Put in Bay, Ohio:				
Carp		2,600,000		2,600,000
Pike perch		108,000,000		108,000,000
Smallmouth black bass			382	382
Whitefish	1,250,000	62,740,000		63,990,000
Yellow perch		1,125,000		1,125,000
Quinault, Wash.:				
Brook trout			137,300	137,300
Chinook salmon			48,750	48,750
Silver salmon	*819,216		353,000	1,172,216
Sockeye salmon	*114,000	11,050,000	1,219,540	12,383,540
St. Johnsbury, Vt.:				
Brook trout		1,714,000	8,849	1,722,849
Steelhead salmon		16,000	14,600	30,600
Pittsford, Vt.—				
Black-spotted trout	50,000			50,000
Brook trout	80,000	180,000	14,835	274,835
Landlocked salmon			2,500	2,500
Rainbow trout	13,000		2,950	15,950
York Pond, N. H.—				
Brook trout	*400,000	335,053	142,489	877,542
Landlocked salmon			988	988
San Marcos, Tex.:				
Largemouth black bass			213,455	213,455
Crappie			5,820	5,820
Rio Grande perch			5,846	5,846
Rock bass			1,850	1,850
Sunfish			66,090	66,090
Warmouth bass			1,705	1,705
Lake Worth, Tex.—				
Largemouth black bass			7,925	7,925
Catfish			950	950
Crappie			93,870	93,870
Warmouth bass			9,900	9,900
Medina Lake, Tex.—				
Largemouth black bass			7,347	7,347
Rainbow trout			1,120	1,120
Sunfish			3,070	3,070
New Braunfels, Tex.—				
Largemouth black bass			10,361	10,361
Sunfish			75,180	75,180
Warmouth bass			2,500	2,500
Saratoga, Wyo.:				
Black-spotted trout			440,000	440,000
Brook trout			563,200	563,200
Loch Leven trout			123,000	123,000
Rainbow trout			179,000	179,000
Lost Creek, Wyo.: Rainbow trout	*657,000			657,000
Spearfish, S. Dak.:				
Brook trout			822,064	822,064
Loch Leven trout			256,300	256,300
Rainbow trout	*16,457		231,950	248,407
Crawford, Nebr.—				
Brook trout			30,900	30,900
Catfish			1,650	1,650
Loch Leven trout			47,000	47,000
Rainbow trout			16,000	16,000
Sunfish			155,550	155,550
Yellow perch			15,625	15,625
Springville, Utah:				
Brook trout	(*)		519,000	519,000
Rainbow trout	643,000		[11] 980,000	1,623,000

[9] In addition to 4,977,000 turned over to the State of Michigan in cooperative work.
[10] In addition to 3,750,000 turned over to the State of Michigan in cooperative work.
[11] In addition to 50,000 turned over to the State of Utah in cooperative work.

Stations and substations operated and output of each, fiscal year 1930—Contd.

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Tupelo, Miss.:				
Largemouth black bass		296,000	106,605	402,605
Catfish			3,450	3,450
Sunfish			398,385	398,385
Aliceville, Ala.—				
Largemouth black bass			4,000	4,000
Sunfish			36,850	36,850
Friar Point, Miss.—				
Largemouth black bass			317,544	317,544
Buffalofish			29,699	29,699
Carp			693,987	693,987
Catfish			1,165,218	1,165,218
Crappie			268,120	268,120
Fresh-water drum			372	372
Pike and pickerel			5,894	5,894
Sunfish			2,310,732	2,310,732
White bass			4,291	4,291
White Sulphur Springs, W. Va.:				
Largemouth black bass			12,700	12,700
Brook trout			[12] 1,974,617	1,974,617
Loch Leven trout			[13] [14] 464,210	464,210
Rainbow trout	515,650		[15] [16] 427,129	942,779
Rock bass			5,210	5,210
Sunfish			10,206	10,206
Woods Hole, Mass.:				
Mackerel		16,502,000		16,502,000
Winter flounder	6,962,000	735,389,000		742,351,000
Wytheville, Va.:				
Largemouth black bass			1,370	1,370
Brook trout			[17] 149,000	149,000
Rainbow trout			[18] 345,030	345,030
Rock bass			19,450	19,450
Smallmouth black bass			800	800
Sunfish			47,500	47,500
Yes Bay, Alaska:				
Humpback salmon		1,389,000		1,389,000
Sockeye salmon		330,000	2,440,000	2,770,000
Steelhead salmon			82,000	82,000

[12] In addition to 110,000 turned over to the State of Virginia in cooperative work.
[13] In addition to 670,000 turned over to the State of West Virginia in cooperative work.
[14] In addition to 96,000 turned over to the State of Virginia in cooperative work.
[15] In addition to 5,000 turned over to the State of West Virginia in cooperative work.
[16] In addition to 113,630 turned over to the State of West Virginia in cooperative work.
[17] In addition to 79,000 turned over to the State of Virginia in cooperative work.
[18] In addition to 149,000 turned over to the State of Virginia in cooperative work.

EGG COLLECTIONS

As would be expected from the fact of an increased output for the fiscal year, egg collections were materially in excess of those for 1929—the increase being close to 1,000,000,000. Collections of eggs of the cod, pollock, winter flounder, pike perch, whitefish, black-spotted trout, and other species of trout were important factors in accounting for the enlargement. Several new field stations for the collection of eggs from wild trout were opened during the year, notably in Colorado and New Mexico. Loch Leven trout egg collections from the Madison River, Mont., eclipsed previous records. Further expansion of the output from station brood stock kept the purchase of commercial trout eggs from private hatcheries at a minimum; practically the only eggs secured from this source being utilized to stock cooperative hatcheries, which represented a new and additional demand. Where the bureau is able to increase its collections, both of the trout and commercial species, beyond the hatching or rearing capacity of its own hatcheries, the surplus is assigned to State hatcheries, either for their outright disposal or for hatching and rearing for subsequent distribution by the bureau.

Comparison of egg collections, fiscal years 1930 and 1929

Species	1930	1929	Species	1930	1929
Buffalofish	35,775,000	49,396,000	Black-spotted trout	18,915,000	16,202,200
White sucker	6,750,000	1,800,000	Loch Leven trout	19,391,200	15,048,100
Carp	98,625,000	28,050,000	Lake trout	58,511,420	65,354,400
Shad	7,011,000	83,806,000	Brook trout	17,094,660	16,686,110
Glut herring	30,700,000	37,740,000	Mackerel	17,759,000	3,482,000
Whitefish	240,638,000	149,712,000	Pike perch	396,325,000	228,303,000
Cisco	75,490,000	241,901,250	Yellow perch	190,490,000	214,835,000
Chinook salmon	27,400,600	49,830,200	Striped bass		13,786,000
Chum salmon	26,562,000	23,467,000	Cod	2,425,992,000	2,244,467,000
Humpback salmon	6,918,800	4,428,800	Haddock	394,575,000	475,737,000
Silver salmon	7,433,500	9,104,300	Pollock	1,028,433,000	596,132,000
Sockeye salmon	54,160,120	51,038,120	Winter flounder	3,637,839,000	3,219,880,000
Steelhead salmon	4,975,300	9,293,300			
Landlocked salmon	592,970	1,157,880	Total	8,849,612,660	7,870,015,000
Rainbow trout	21,255,090	19,377,340			

Egg-collecting stations

Station	Period of operation	Species handled
Baker Lake, Wash.: Brinnon, Wash	Nov. 25–Dec. 24	Chum salmon.
Boothbay Harbor, Me.:		
Damiscove, Me	Apr. 1–June 1	Cod.
Ebenecook Harbor, Me	Mar. 5–Apr. 9	Winter flounder.
Fisherman Island Passage, Me	Apr. 12–May 28	Cod and haddock.
Johns Bay, Me	Mar. 5–Apr. 15	Winter flounder.
	Apr. 1–May 17	Cod.
Knubble Bay, Me	Mar. 17–Apr. 8	Do.
Linekins Bay, Me	Mar. 10–Apr. 15	Do.
Little River, Me	Mar. 10–Mar. 24	Do.
Muscungus Bay, Me	Mar. 31–June 1	Cod and haddock.
Robin Hoods Cove, Me	Mar. 6–Apr. 8	Winter flounder.
Sheepscott Bay, Me	Apr. 1–June 21	Cod and haddock.
Sheepscott River, Me	Mar. 5–Apr. 9	Winter flounder.
	Apr. 1–June 1	Cod.
Cape Vincent, N. Y.:		
Chaumont Bay, N. Y	Nov. 10–Dec. 2	Whitefish and cisco.
Fairhaven Bay, N. Y	Nov. 16–Dec. 3	Cisco.
Indian Point, Ontario	Nov. 15–Nov. 30	Do.
Ling Point, Ontario	Oct. 25–Nov. 6	Lake trout.
Pigeon Island, Ontario	Oct. 16–Nov. 5	Do.
Simcoe Island, Ontario	do	Do.
Sodus Bay, N. Y	Nov. 15–Dec. 2	Cisco.
South Bay, N. Y	Apr. 21	Pike perch.
Clackamas, Oreg.:		
Jimmy Smith Lake, Idaho	June 7–June 27	Rainbow trout.
Williams Lake, Idaho	Apr. 20–May 16	Do.
Upper Clackamas River, Oreg	Sept. 4–Sept. 20	Chinook salmon.
Duluth, Minn.:		
Bayfield, Wis	Nov. 22–Nov. 30	Cisco.
Bemidji, Minn	Apr. 16–Apr. 30	Pike perch.
Betsy River, Mich	Oct. 14–Oct. 27	Lake trout.
Big Traverse Bay, Mich	do	Do.
Copper Harbor, Mich	Sept. 25–Oct. 9	Do.
Gay, Mich	Oct. 14–Oct. 27	Do.
Grand Marais, Mich	Oct. 17–Nov. 5	Do.
Huron Island, Mich	Oct. 14–Oct. 26	Do.
Isle Royale (Mich.) ports	Sept. 25–Nov. 17	Lake trout and whitefish.
Keystone, Mich	Oct. 14–Oct. 25	Lake trout.
Manitou Island, Mich	Oct. 13–Oct. 19	Do.
Marquette, Mich	Oct. 14–Oct. 29	Do.
Munising, Mich	Oct. 15–Oct. 27	Do.
Portage Entry, Mich	Oct. 14–Oct. 27	Do.
Portage Lake Ship Canal, Mich	Oct. 10–Oct. 27	Do.
Gloucester, Mass.:		
Boars Head, N. H	Feb. 1–May 20	Cod.
Marblehead, Mass	Feb. 20–Mar. 15	Do.
Plymouth, Mass	Nov. 1–Mar. 10	Cod and pollock.
Rockport, Mass	Nov. 1–May 20	Pollock, cod, haddock.
Leadville, Colo.:		
Continental Reservoir, Colo	May 12–June 22	Black-spotted trout.
Eagle Nest Lake, N. Mex	Apr. 15–June 12	Rainbow trout.
Mount Massive Club Lakes, Colo	Oct. 16–Dec. 11	Brook trout.
Trinchera Reservoir, Colo	May 1–June 13	Rainbow trout.
Turquoise Lake, Colo	Oct. 19–Dec. 7	Brook trout.
Wurts Lakes, Colo	Oct. 18–Nov. 22	Do.
Nashua, N. H.· Lebanon, N. H	Apr. 3–Apr. 14	Rainbow trout

Egg-collecting stations—Continued

Station	Period of operation	Species handled
Northville, Mich.:		
Alcona, Mich	Nov. 1–Nov. 3	Lake trout.
Beaver Island, Mich	Oct 17–Nov. 24	Do.
Black River, Mich	Nov. 3–Nov. 6	Do.
Cheboygan, Mich	Oct. 26–Nov. 23	Lake trout and whitefish.
Detour, Mich	Oct. 29–Nov. 6	Lake trout.
Epoufette, Mich	Nov. 8–Nov. 20	Whitefish.
Fairport, Mich	Nov. 12–Nov. 17	Do.
Leland, Mich	Nov. 12–Nov. 24	Lake trout.
Manistique, Mich	Nov. 12–Nov. 17	Whitefish.
Middle Island, Mich	Oct. 30–Nov. 2	Lake trout.
Northport, Mich	Nov. 12–Nov. 24	Do.
Oscoda, Mich	Nov. 6–Nov. 15	Do.
Rockport, Mich	Oct. 26–Nov. 26	Lake trout and whitefish.
St. Ignace, Mich	Oct. 26–Nov. 24	Do.
Put in Bay, Ohio:		
Catawba Island, Ohio	Nov. 6–Nov. 30	Whitefish.
Middle Bass, Ohio	Nov. 6–Nov. 28	Do.
	Apr. 8–May 1	Pike perch.
North Bass, Ohio	Nov. 6–Nov. 28	Whitefish.
	Apr. 8–May 1	Pike perch.
Port Clinton, Ohio	Nov. 6–Nov. 30	Whitefish.
	Apr. 7–May 5	Pike perch, yellow perch.
	June 2–June 23	Carp.
Toledo, Ohio	Nov. 7–Nov. 30	Whitefish.
	Apr. 7–May 5	Pike perch.
Saratoga, Wyo.:		
Big Creek Lakes, Colo	Sept. 9–Nov. 2	Brook trout.
Lost Creek, Wyo	Mar. 24–June 21	Rainbow trout.
Springville, Utah:		
Fish Lake, Utah	Oct. 28–Dec. 10	Brook trout.
	Apr. 22–May 16	Rainbow trout.
Pyramid Lake, Nev	Apr. 4–Apr. 17	Black-spotted trout.
Woods Hole, Mass.:		
Groton, Conn	Mar. to Apr. 5	Cod, haddock, winter flounder.
Waquoit, Mass	Jan. to Apr	Winter flounder

FISH-CULTURAL NOTES

NEW STATIONS

Among the new plants to which reference was made in the previous year's report the substations at Crawford, Nebr., and Fort Worth, Tex., are now operating close to full production with present facilities. At the former point a good distribution of trout was achieved and work was started on the construction of a dam to create a large lake on the Fort Robinson Military Reservation for the propagation of warm-water fish. A number of small local ponds were utilized for producing a limited number of bream, catfish, etc. The ultimate capacity for rearing trout at Crawford will not be attained until a pipe line, connecting a spring-water supply, is run to the present hatchery. This work was in progress at the close of the fiscal year. Development has continued at the Valdosta (Ga.) station; and a limited distribution of bass and bream, principally the latter, was obtained for the benefit of local waters. In view of the extensive pond acreage at this point, the securing of an adequate brood stock has been slow and difficult. Additional drainage wells will be drilled to facilitate the drainage of Grassy Lake, the main hatching and rearing pond.

At the Tishomingo (Okla.) substation, buildings were constructed; and a temporary dam, designed to give an immediate water supply for a small number of ponds, was installed. High

water during the spring destroyed this structure, and no fish-cultural work could be carried on during the summer of 1930. At the close of the fiscal year, work had just been started on a permanent dam and ditch which will insure an adequate water supply for ponds to be constructed later. A hatchery building and a combination workshop and garage were completed at the Creede (Colo.) substation, and work was started on a dwelling. This new project hatched a considerable number of trout eggs during the winter and was the base for new field egg-collecting operations in southern Colorado and northern New Mexico. Minor expansion of facilities occurred during the year as is shown in the individual reports.

FIVE-YEAR EXPANSION PROGRAM

Final enactment by Congress, during May, of the 5-year expansion program for the bureau provided for over 30 new or expanded fish-cultural activities. The new hatcheries authorized under the terms of this legislation are located throughout the country in sections which are not easily cared for by the bureau's existing hatcheries. While no new work under the authorization of this bill was undertaken during the fiscal year 1930, the matter is mentioned as an indication of the viewpoint of Congress relative to the desirability of expanding Federal fish-cultural operations. At the end of the 5-year period covered by the program the stations and activities of the division of fish culture will have been virtually doubled in number and magnitude. The major part of the development is to be devoted to the interests of game-fish propagation.

FISH FOOD

The report for 1929 mentioned an experiment with a prepared trout food made from dried salmon eggs as being under way at the Bozeman (Mont.) station. On the basis of favorable results the experimental trout station at Pittsford, Vt., utilized some of this material, and preliminary findings indicate that it has high value, both in producing growth and in giving the high coloration characteristic of wild fish.

REFRIGERATING PLANT FOR FISH FOOD

During the year there was installed at the Little White Salmon (Wash.) substation a complete cold storage and refrigerating plant for the purpose of freezing and holding spawned-out salmon carcasses to be utilized as fish food at the Columbia River stations. It is believed that frozen salmon carcasses are more suitable for feeding young salmon than those which have been preserved by salting or other methods. In view of the low cost of the raw materials, it is believed that its preservation by refrigeration will provide a cheap and satisfactory food, and that the refrigerating plant will ultimately represent a real economy.

BLACK-SPOTTED TROUT EGG COLLECTIONS, PYRAMID LAKE, NEV.

In cooperation with the State of Nevada, Pyramid Lake, which is located on lands belonging to the Carson Indian School, was taken

over during the spring of 1930 by the bureau as a field collecting station for black-spotted trout eggs. This was formerly a productive source of early black-spotted trout eggs, but difficulties arising with the Indians who control operations at this point prevented the State of Nevada from continuing. By the time the necessary permission was received from the Indians for the bureau to proceed, the season had virtually passed and collections were negligible. The work will be followed up, however, and the total output replanted in the lake for a number of years with the object of restoring it to its former productivity.

DISTRIBUTION BY TRUCK

A number of the eastern stations are distributing increasing proportions of their output by motor truck. Unlike the practices followed in the West, where transportation trucks are equipped with air compressors or oxygen tanks, the bureau is utilizing an ordinary aluminum distribution pail and is depending upon the motion arising from the travel to provide aeration. It has been found quite practicable to distribute trout and bass in this manner within a radius of practically 100 miles from the station. While the charging of the initial cost of the truck and all cost of maintenance and upkeep to distribution might result in an expense equivalent to, or slightly above, the cost by rail, the fact remains that these stations maintain a truck for other purposes. Hence no additional overhead or other expense is involved in utilizing them for distribution purposes. It is probable that, as the number of stations is increased and the distribution hauls shortened, there will be a considerable increase in this method of transporting fish.

EFFECT OF WEATHER CONDITIONS ON FISH CULTURE

The past year presented a particularly striking example of the hindrance which may be exerted on fish-cultural operations by unfavorable weather. During the fall the lake trout egg collections at the Duluth (Minn.) station were reduced to a small fraction of normal on account of gales on Lake Superior preventing fishing operations. Floods during May at the San Marcos (Tex.) station overran the grounds and curtailed what had promised to be a very satisfactory distribution of pondfish. Unseasonable and cold weather during the spring reduced the production of pondfish at the South Carolina and Georgia stations. Operations with the shad at Fort Humphreys, Va., and the striped bass at Weldon, N. C., were a virtual failure owing to abnormal water conditions arising from prolonged dry weather preceding the spawning season. By the close of the fiscal year the continuation of this drought had seriously affected the water supply at a number of the eastern trout stations; and unless normal conditions return shortly, the water shortage may be reflected in subsequent egg collections at these points. Dry weather conditions on the Pacific coast have affected the flow in some of the salmon streams, preventing or discouraging the entrance of the fish and causing a shortage in the collection of eggs.

COMMERCIAL SPECIES

The propagation of commercial species of fish is a contribution to the public good, the exact results and value of which can not be accurately estimated. The intensive stocking of specific locations for a period of years with commercial forms, such as the flounder, whitefish, lake trout, or the Pacific salmon, has clearly demonstrated, by the increased catches of fish, that worthwhile results are obtainable. The general work of this nature, however, is more widespread and divergent, and the results of the hatchery operations are obscured by normal fluctuations in catch; traceable, in part, to other factors such as weather conditions.

The artificial propagation of commercial forms may be considered as supplementary to the natural reproduction arising from the vast natural stock which must be existent to support a commercial fishery. The comparatively limited cost per unit of production, however, makes it highly desirable to assist nature by hatchery operations. As has been previously pointed out, the increased aggregate production for the past year is due largely to the augmented distribution of eggs and fry of the commercial species. One of the most noteworthy features in connection with this work during 1930 was the virtual failure of all shad operations, due to water conditions arising from drought.

PACIFIC SALMONS

On the Pacific coast field, operation of the salmon hatcheries was marked by a practically normal output at the Alaska stations, a moderate increase in the California field, and sharp declines in the output of the Puget Sound and Columbia River establishments. The latter condition was due to prolonged dry weather which brought the rivers to an extremely low level and deranged the normal spawning migrations. The decline was particularly noticeable in the case of chinook and sockeye salmon; while the only forms that registered an increase were the humpback and steelhead trout.

AFOGNAK (ALASKA) STATION

[A. T. Looff and Harry F. Johnston, Superintendents]

The escapement of sockeye salmon into Letnik Lake during the season of 1929 amounted to 25,428. Of these, 8,360 female fish were spawned. They yielded 22,000,120 eggs of good quality, of which 4,553,200 were forwarded, when eyed, to the bureau's headquarters at Seattle, Wash. All the young salmon hatched were retained and fed, well into the month of June, before being liberated in the lake and its tributaries. Early in May steelhead-salmon eggs to the number of 123,904 were collected at the outlet of Letnik Lake and by the close of the fiscal year had attained the eyed stage. The migration of sockeyes occurred during a high-water period in May; and while schools of considerable extent were observed in tributaries of the lake, it was impossible, owing to the roily condition of the water, to form any estimate of the number migrating.

Saw logs, cut during the winter in the woods and transferred to the station sawmill, were made into lumber. Forty thousand board feet of suitable sizes for future construction and repair work were manufactured from 170 logs, with 50 logs remaining to be cut. In the course of the year a new woodshed was constructed, a bridge was built across Hatchery Creek on the station grounds, and several other improvements of a minor character were made. The construction of a highway 4½ miles in length, between the station and the boat landing at Letnik Bay was started June 14 and the work was com-

pleted on November 30, 1929. The building of this road was financed and supervised by the Bureau of Public Roads. Its completion has made possible the use of a truck, thus expediting the station's activities to a considerable extent.

YES BAY (ALASKA) STATION

[A. T. Looff, Superintendent]

Fish-cultural work at this station during the fiscal year 1930 was concerned chiefly with the sockeye salmon, though limited numbers of humpback salmon were also handled. While the egg collections of the first-named species were somewhat below the average, an abundant supply of excellent food material, made available through the cooperation of the New England Fish Co. of Ketchikan, Alaska, permitted the feeding of the fingerlings for a much longer period than has been possible heretofore in this field. The protection afforded the fish from their natural enemies by their increased growth and development before liberation should be productive of satisfactory results. Two million four hundred and forty thousand young sockeye salmon carried over from last year's stock, were held in ponds and fed until July 27 and then released as fingerlings No. 2 in Lake McDonald. The season's spawn-taking operations yielded 16,095,000 eggs of the sockeye salmon and 2,650,000 of the humpback salmon. Of the fry hatched from the former, 330,000 were planted in the hatchery slough as advanced fry, 6,002,000 were released in Lake McDonald in the No. 1 fingerling stage, and 8,000,000 fingerlings No. 2 were being fed in the station ponds when the year closed. On reaching the eyed stage 1,021,000 of the humpback eggs were distributed. The remainder were incubated, producing 1,389,000 fish which were planted in the hatchery slough in the advanced fry stage.

Owing to the extremely wet climate in this region, walks, building foundations, tramways, and in fact all equipment of wood construction are subject to rapid decay. Frequent repairs and replacements are essential to maintain them in first-class condition. Many items of repair of a miscellaneous nature were attended to in the course of the year, one of the most important being the rebuilding of 2,200 feet of pipe-line trestle. The capacity of the station's feeding pond system was increased considerably by the extension of feeding walks to the upper portion of the hatchery slough.

BIRDSVIEW (WASH.) STATION AND SUBSTATIONS

[Joseph Kemmerich, Superintendent]

Operations in Baker Lake field were conducted throughout the entire year at the five permanently established stations. In addition the Walcotts Slough trap at Brinnon, Wash., was operated from November 25 to December 24; and from February 11 to June 27, sockeye salmon rearing operations were in progress at the Lake Crescent State hatchery. Eggs of the five species of Pacific salmon and steelhead were handled. The run of chum salmon in Duckabush River and in Walcotts Slough was the largest in recent years, and a capacity collection of these eggs was made at the Hoods Canal substations. The humpback-salmon egg collection at Birdsview exceeded that of any year since 1907. Egg collections of the other four species handled were below normal, however, and unfavorable weather conditions were partly attributable therefor. The total egg collection at all points amounted to 37,417,500, exceeding by 7,097,700 the take of the previous year, but falling short of the collection in 1928 by 6,320,000. In addition to the eggs collected 7,392,152 were received by transfer from other fields and handled in connection with those taken locally. Eyed eggs to the number of 2,620,500 of the different species were shipped to points in various States, to Hawaii, and to South America. The Birdsview and Quilcene stations cooperated with the Skagit and Jefferson County game commissions, respectively, in hatching and rearing trout.

Fluke-infested liver was fed in all fields with apparently satisfactory results, and at a considerable saving in cost as compared with former years. Experiments were conducted with various foods with the view of ascertaining which would give the best satisfaction in combination with salted salmon. Continued investigation of streams in the Puget Sound watershed was made during the year and considerable information gained concerning the spawning grounds of the chinook and humpback salmons. Notwithstanding the fact that all streams

were at an unusually low stage throughout the entire fall there was a good run of the chinook and humpback salmon. Streams, lakes, and springs in the Mount Rainier National Park were inspected in a search for a suitable trout rearing site. Though alterations were made in the device for the hoisting of the 1929 run of fish over the power dam in Baker River at Concrete, Wash., there was no improvement in the results. Of the 1,379 sockeye salmon put over the dam only 960 ascended to Baker Lake, and the total egg collection amounted to 765,000. The comparative insignificance of this work is brought out by the fact that during the fiscal year 1924, which immediately preceded the installation of the Baker River Dam, 14,558 sockeyes were caught in Baker Lake and 22,000,000 eggs secured from them.

Birdsview (Wash.) station.—The exteriors of all station buildings were painted two coats and the interiors of several of the cottages were repainted. Minor repairs and alterations were made to the fish-culturist's cottage and several other buildings. Late in August a temporary wood trap was constructed in Phinney Creek with the object of collecting humpback and chinook salmon eggs. Throughout the spawning period of the chinook, humpback, and sockeye salmons the water level in Grandy Creek remained too low for the ascent of fish, but a slight rise occurring after December 10 permitted the entrance of a small run of silver salmon from which eggs to the number of 1,218,000—about half the take of a normal season—were secured. The run of steelhead salmon was also small, and the take of eggs amounted to not more than one-third the average collection. From Phinney Creek 3,325,000 humpback salmon eggs and 180,000 chinook eggs were obtained between September 7 and October 14, the former figure representing the largest season's collection ever made in that stream. In addition to the local egg collections, shipments from other fields received and handled comprised 214,816, sockeye; 2,842,000, chinook; 1,671,320, silver; 1,021,000, humpback; 250,000, chum; and 209,000, steelhead salmon eggs. Consignments of eyed eggs forwarded from Birdsview to destinations in the various States, Hawaii, and South America included 285,000 chum salmon; 1,021.000 humpback salmon; 250,000 chum salmon; 114,000 sockeye salmon; 225,000 silver salmon; and 588,000 steelhead-salmon eggs. Feeding operations were conducted to the full capacity of the station in July and August, and again in the spring from April 1 to the close of the year. In an effort to determine whether age or size is the factor governing the return of the fish, 48,000 yearling sockeye salmon were marked and liberated in Skagit River.

Baker Lake (Wash.) substation.—Only such minor repairs and improvements were made as were essential to the maintenance and proper operations of the station. The 522,500 sockeye fingerlings on hand at the beginning of the fiscal year were all liberated by July 27. Of the 765,000 sockeye eggs secured, 100,000 were transferred to the Birdsview station. The fingerlings resulting from the remainder were liberated in Baker Lake prior to the close of the year. Silver salmon to the number of 5,876 were put over the dam. Of these, 1,428 ascended to the station where 1,529,000 eggs were taken from them and transferred to Birdsview. A considerable run of landlocked sockeye salmon again entered Baker Lake, but only a few were caught as the trap webbing meshes were too large to intercept them.

Duckabush (Wash.) substation.—During August the temporary trap was installed in the Duckabush River for collecting eggs of the early run chum and humpback salmons, and on October 1, when all eggs that could be cared for at the Duckabush and Quilcene stations had been secured, it was removed. All station buildings were painted, 40 new troughs and a new head trough installed in the hatchery, and the permanent trap, which had been damaged by flood waters on November 12, 1928, was repaired and lengthened 48 feet in order to allow flood waters a greater escapement area. In the Duckabush River the early run of chum salmon was the largest in years, while the run of humpback salmon appeared to be fully as large as two years ago. At the temporary trap in the river, 10,165,000 eggs of the early chum salmon and 812,000 of the humpback salmon were collected between September 5 and 28. On account of shortage in the hatchery water, 4,256,000 of the chum eggs had to be cared for at the Quilcene station until late November, when the water supply increased sufficiently to permit of their return to Duckabush for the completion of incubation. There were also collected for the Quilcene station 3,606,000 early chum eggs and 127,000 of the humpback salmon. The maximum numbers of eggs of both species that could be handled in these fields having been collected by October 1, steps were

taken on that date to remove the temporary trap and allow the remainder of the run to ascend the river. At the Walcotts slough trap, 5,010,000 eggs of the late run of chum salmon were obtained between December 15 and 24.

The runs of silver and steelhead salmon in the Duckabush River, apparently, were below normal, and the egg collections of both species were small. A lot of 753,600 eyed silver-salmon eggs was received from the Quinault station and handled in connection with the local collections. The effort undertaken in 1925 to establish a run of chinook salmon in the Duckabush River was continued, the product of 300,000 eggs of that species transferred during November from the Little White Salmon station being utilized for the purpose. The feeding of chinook, silver, and steelhead salmon fingerlings was prosecuted to the station's capacity. The only stock remaining on hand when the year closed was a lot of 46,600 steelhead fingerlings.

Quilcene (Wash.) substation.—All station buildings were painted, and the interiors of the two cottages repainted and varnished. With the view of increasing the hatching capacity of the station, which of late years has been too small to accommodate all eggs available, an outside battery of 36 troughs was constructed at the rear of the hatchery building. At the beginning of the fiscal year there were on hand 135,000 fry and 300,000 fingerling steelhead salmon. These fish were distributed before the close of July. The run of chum and silver salmon was below normal but the steelhead salmon egg collection was larger than in recent years. The short run of the two first named species is attributed to the low water level in the Big Quilcene River during the early part of the season. A total of 1,630,000 early-run chum salmon eggs was obtained from the Big Quilcene and Little Quilcene River traps between September 5 and October 1. This collection was augmented by 3,606,000 eggs of the same species obtained at the Duckabush River temporary trap between September 28 and October 1, and 4,256,000 of these eggs were eyed for the Duckabush station, owing to an inadequate water supply at that hatchery. Silver salmon eggs were collected from November 25 to February 19 to the amount of 948,000, and 716,064 of that species were received from the Quinault field.

Steelhead-salmon eggs to a total of 578,000 were collected between February 26 and May 10. Chum salmon to the number of 250,000 and 69,000 steelhead-salmon eggs were transferred to the Birdsview station. In continuation of the effort undertaken several years ago to establish a run of chinook salmon in the Big Quilcene River and Lyre River and to increase the run in the Docewallips River, 300,000 eggs of that species were transferred from the Little White Salmon station, hatched, and the resulting fry and fingerlings liberated in these streams. One hundred thousand eastern brook trout eggs were received from Colorado. During the spring months feeding operations to the capacity of the station were conducted.

Walcotts Slough (Wash.) substation.—Collections of late chum salmon eggs were made jointly at this point for stocking the Duckabush and Quilcene hatcheries. From November 25 to December 17 employees of the former secured 5,027,000, and an approximately equal number was obtained by the Duckabush personnel between the 15th and 24th of that month. On the latter date the trap was opened and the remainder of the run given access to the entire slough for natural spawning. At least 5,000,000 additional eggs might have been collected had space for developing them been available at the Hoods Canal stations. All fry resulting from the collections made at this point for the Duckabush and Quilcene stations were returned at the expiration of the sac stage to their native waters.

Sultan (Wash.) substation.—Early in September a temporary rack was installed in Elwell Creek with the intention of trapping the run of chinook and humpback salmon. The efforts were rendered almost futile, however, by the extremely low-water level prevailing and a sudden flood occurring on October 17. The young fish developed from the 37,000 eggs and 404,000 fry of the steelhead salmon on hand at the opening of the year were all distributed before the end of July. In the face of the unfavorable water conditions the collection of eggs was far below normal, the total of the four species handled amounting to only 837,500. Part of the steelhead eggs secured were transferred to the Birdsview station. All of the chinook, humpback, and silver salmon produced were liberated before the close of the fiscal year, and only a small stock of steelhead fry and fingerling fish were on hand at that time.

Lake Crescent (Wash.) State trout hatchery.—In continuation of the attempt begun in 1927 to establish a run of sockeye salmon in Lake Crescent

through the Lyre River from Puget Sound, eyed eggs of that species to the number of 1,028,350 were transferred to the station from the Quinault field, with the view of rearing the resulting fry to the fingerling stage before liberating them. The young fish were fed from April 26 to June 27 when the resulting fingerlings, amounting to 953,500, were planted in the lake. Returns in the Lyre River are expected this summer from the first fish liberated in Lake Crescent in June, 1927, and accordingly a close watch is being maintained.

QUINAULT (WASH.) STATION

[Marcus S. Meyer, Superintendent]

The fish-cultural work of this station is directed principally to the propagation of sockeye salmon. During the fall spawning season from November 3 to December 30, 15,300,000 eggs of this species were collected, together with 3,000,000 of the silver salmon and a small number of chinook-salmon eggs. Practically throughout the spawning season the water in the streams of the region was at an extremely low stage. This caused many of the fish to spawn

Figure 1.—Upstream view of mechanical fish screen in irrigation canal near Yakima, Wash. Installed to overcome loss of young salmon in ditches

along the shores of the lake and rendered the movement of fish canoes and equipment a somewhat laborious task. In order to provide sufficient room for the development of the sockeye-salmon fry it was found necessary to transfer the silver-salmon eggs in the eyed stage to other stations for the completion of incubation. The stacked-tray system for handling the fry was used with excellent results. A large pool just below the falls in Falls Creek was screened off and used for the rearing of 500,000 of the fingerling salmon after filling the hatchery and station ponds to capacity.

Extensive repairs were made to the hatchery building early in the fiscal year. The foundation being bady rotted, it became necessary to renew foundation posts, sills, floor joists, and flooring. While such work was going on, the hatching troughs were removed to the station workshop; and, after completing repairs to the building, new trough horses were constructed and the troughs were again set up and painted. A 65-foot section of the flume supplying water for grinding fish food was rebuilt; and a temporary flume, 200 feet in length, was constructed from the hatchery head trough to connect with the flume just above the hatchery settling tank. The purpose of this flume is to supply water to the hatchery while a new concrete settling tank was in course of construction.

CLACKAMAS (OREG.) STATION AND SUBSTATIONS

[PHILO B. HAWLEY, Superintendent]

Operations in the Oregon field were conducted at six permanent stations, and efforts were directed toward the maintenance of the run of salmon in the States of Oregon, Idaho, and Washington. The fish-cultural work at these stations was concerned chiefly with the propagation of the chinook and steelhead salmons, though small numbers of the silver, chum, and sockeye salmons were also handled, as well as several species of trout. The total egg collections amounted to only 22,500,000, as compared with approximately 52,000,000 in the preceding year. The very decided falling off in results is attributed to the extremly low-water stages which prevailed in nearly all streams throughout the field. As in previous reports acknowledgement is made of the very hearty cooperation afforded by the Oregon State Fish and Game Commission, both financially and otherwise.

Clackamas (Oreg.) station.—Owing to repeated failure of egg collecting operations in the Clackamas River during the seasons of 1928 and 1929, no racks were installed; and it transpired that such action was justifiable, since only a very few chinook salmon ascended the stream. To offset this failure to secure spawn 1,230,000 eggs of this species were transferred from other points and the resulting fish were reared to the No. 2 fingerling stage before liberation. All eggs collected at the upper Clackamas substation were also hatched here; and the fish produced therefrom were returned, in the No. 2 fingerling stage, for planting in the waters from which they were derived. Shipments of steelhead, rainbow, and brook trout eggs were also handled. Facilities at this station have recently been improved by the installation of a cold-storage room for the preservation of fish food. This room has a capacity for holding 2 tons of meat. In cooperation with Oregon Game Commission fishery exhibits were displayed at the State fair at Salem, Oreg., and at the Pacific Coast International Stock Show at Portland. Both exhibits occasioned favorable comment.

Little White Salmon (Wash.) substation.—The construction of the cold-storage plant at this station, undertaken prior to the beginning of the year, was completed. This plant which provides for the freezing of 2 tons of fish in 24 hours and has a holding capacity of 70 tons, will be used for the storage of food for both the Little White Salmon and Big White Salmon stations. A number of skiffs were constructed for use in this and in other fields. Chinook-salmon egg collections were the poorest in years, only 9,830,000 being secured as compared with 20,172,000 in 1928, and 26,600,000 in 1927. Increased commercial fishing is given as one reason for this. About 500,000 chum-salmon eggs were also collected and nearly 2,000,000 chinook eggs were transferred here from other collecting points. A normal percentage of hatch was secured and the resulting fry were held by the stacked-tray system. The young fish were fed on horse meat and spawned-out salmon preserved by freezing, about 8 tons of the latter being used for food in the course of the season.

Big White Salmon (Wash.) substation.—The usual preparations were made for the collection of chinook-salmon eggs in the Big White Salmon River and Spring Creek. The latter was formerly barren of salmon, but through the efforts of the station in making frequent and heavy plants of young fish, a run of salmon was established and has been built up to very fair proportions. The season's collection of eggs proved disappointing, only 5,845,000 being obtained. By means of the station truck, the eggs collected in the Big White Salmon River were successfully transported from the racks to the hatchery in the green state. Five hundred and fifty thousand of the eggs were transferred to the main station at Clackamas. From the eggs retained a normal percentage of hatch was secured and nearly 5,000,000 fish were reared to No. 2 and No. 2½ fingerlings for liberation in the Columbia River. Spawned-out salmon to the amount of 4 tons, preserved at the Little White Salmon station by freezing, was fed to the young fish in connection with 7,000 pounds of horse meat and liver. In addition to the propagation of chinook salmon nearly a million brook, rainbow, and steelhead eggs were incubated and the product reared. Most of these were cared for as a courtesy to the Klickitat Game Commission, and the resulting fingerlings were liberated by the commission in mountain lakes and streams in this county. Increased illegal net and troll fishing off the mouths of the Little White Salmon and Big White Salmon Rivers at the time adult

salmon were preparing to ascend these streams necessitated the employ of patrolmen during this period. The bureau employed one man, and another was employed by the Oregon Game Commission.

Rogue River (Oreg.) substation.—Rearing facilities at this point were improved by the installation of a 4-inch centrifugal pump operated by a 10-horsepower electric motor. The chinook spawning season, which opened September 9, was an extremely disappointing one; only 588,000 eggs were secured, representing the smallest take in years. The failure is ascribed in part to the spacing of the head-rack pickets 2½ inches apart instead of 2 inches. This action was taken owing to complaints received from various sportsmen to the effect that the 2-inch spacing prevented steelhead and other trout from ascending the river. No other collections were made but a consignment of sockeye salmon eggs was received. The fry from these were transferred to the Butte Falls hatchery of the Oregon Game Commission for rearing. In cooperation with that commission, a census of the chinook salmon ascending Rogue River to spawn was taken at the Savage Rapids Dam. Up to July 1 approximately 24,000 salmon had ascended.

Applegate Creek (Oreg.) substation.—Approximately 1,700,000 steelhead trout were on hand July 1, 1929, and in the course of that month 1,685,000 of them were liberated in Applegate Creek. The run of silver salmon in this stream was almost a failure, only 190,000 eggs being taken. Very favorable results attended the efforts to collect steelhead eggs and slightly more than 3,000,000 were secured. As a result of severe criticism from sportsmen and others of the region, spawn was this year collected from steelhead trout without killing the fish and all spawned-out fish were returned to the waters of Applegate Creek. After making the desired shipments of eyed steelhead eggs the remaining eggs and fry were transferred to the Butte Falls hatchery of the Oregon Game Commission for rearing. By this means the fish were reared to a larger size than would otherwise have been possible, and the expense of operating the Applegate Creek hatchery during June was eliminated.

Salmon (Idaho) substation.—At the opening of the year 786,000 rainbow-trout eggs were on hand. A consignment of 50,000 of these was transferred to the bureau's Leadville (Colo.) station, and nearly 714,000 fingerling fish, the product of the remainder, were planted in the mountain streams of the region. The run of spring chinook salmon in the Lemhi River was almost a failure, only 351,000 eggs being collected. After carrying them to the eyed stage at the point of collection, these were transferred to the main hatchery at Salmon for the completion of incubation. With the view of assisting to maintain the run of spring chinook salmon in the Salmon River, 2,720,000 eggs were transferred here from the McKenzie hatchery of the Oregon Fish Commission. Of the total of 3,071,000 chinook eggs handled, 3,055,000 were hatched and approximately 3,000,000 No. 1 fingerlings were produced and liberated in the Lemhi River or its tributaries. The State of Idaho cooperated with the bureau in collecting 1,468,000 rainbow-trout eggs in Williams and Jimmy Smith Lakes. With the exception of a normal loss this collection, in the form of eggs and fry, was on hand at the end of June, 1930.

BAIRD (CALIF.) STATION AND SUBSTATIONS

[W. K. Hancock, Superintendent]

General repairs and improvements were made to the station buildings in the summer of 1929. Two new plank and earth ponds were built back of the power house and fed through a flume from a settling tank. Another pond was constructed in front of the mess house and fed from a spring. Seining for chinook salmon in the McCloud River was undertaken on September 3 and continued at intervals until October 14, during which time 500,000 eggs were taken. While this may be considered a small collection, it was much larger than any that had been made in the river in the recent past. Experience having demonstrated that there would be no opportunity to add to it by attempted collections from the limited run of fall fish, the racks were removed from the river at the close of the early run. All spent salmon used in the work were salted down for fish food.

There being no water in the gravity ditch, the eggs were developed in troughs set up outside the hatchery. The stock was held in this way until the growing fish became crowded, when they were transferred to the hatchery.

One million five hundred thousand eyed chinook eggs, received from the Battle Creek auxiliary, were hatched; and from the combined stock, plants of 1,951,000 fingerling fish were made in the McCloud River at Baird and in the Sacramento River near Redding, Calif. Heavy rains in December washed away the flumes at the head of the gravity ditch and necessitated the pumping of water from the river for a period of several weeks while the equipment was undergoing repair. Snow to a depth of 3 feet fell during the winter, this amount exceeding that of any season's snowfall within the past 12 years. The station roads, which were badly damaged by heavy precipitation during the winter, were repaired in the spring with earth and gravel hauled for the purpose. In April, the racks were again installed for the interception of the spring run of salmon. During the early summer, forest fires threatened the destruction of the power lines. They were finally gotten under control by the efforts of a large force of men, and no damage was done to station property. In the course of the year the station superintendent visited the two substations as often as was deemed necessary to exercise general supervision over the work and give needed instructions to the officials in charge.

Battle Creek (Calif.) substation.—During the summer needed repairs and improvements were made on the station buildings. A new pond was constructed across the gulch west of the hatchery. In September racks were installed in Battle Creek, and fishing began on October 1. The run of fish was larger than in some years, and eggs to the number of 7,674,800 were collected. Contrary to recent practice, no seines were operated in the Sacramento River, the full attention of the station force being required in making local collections. On account of the occurrence of heavy storms when the eggs were in the tender stage, many were lost and large numbers of weak fry developed which soon succumbed. Slightly more than two-thirds of the 5,301,000 fry hatched were reared to the fingerling stage, and all fish produced were planted in Battle Creek.

Mill Creek (Calif.) substation.—Prior to the opening of the fishing season the old supply flume from the main ditch to the hatchery, a distance of 225 feet, was rebuilt with a half-circle galvanized-iron flume 2 feet in width and about 12 inches deep, equipped with a concrete head gate. The racks were installed in August and fishing extended from November 6 to December 7, resulting in the collection of 1,800,000 eggs. After the run of fish was over the racks were removed and all equipment was stored, just in time to prevent its washing away by high water. The smaller than normal collection made was due to the refusal of the local irrigation company to turn water into Mill Creek until November 1, by which time most of the fish that would otherwise have entered the creek had passed on up the river. All available water is used during the summer for irrigation and throughout that period the creek is practically dry. The company has promised that during the coming year water will be turned into the creek by the middle of October. From the eggs collected and 600,000 eyed eggs transferred from the Battle Creek substation, 2,385,000 fry were hatched. These were reared until the end of March and then liberated, as the water was taken at that time by the irrigation company. During the short feeding period 1,100 pounds of salmon and 200 pounds of beef melts were consumed.

FISHES OF THE GREAT LAKES

In contrast to conditions during the past two or three years, the aggregate output of whitefish, lake trout, and pike perch was markedly increased. The only variety which failed to reach the numbers of the previous year was the cisco or lake herring. The increase was largely credited to the highly successful operations of the Michigan stations, although the pike-perch output was augmented by a good production at the Put in Bay (Ohio) station. The Cape Vincent (N. Y.) station was materially curtailed in its whitefish and lake-trout operations, as was true with the latter species at the Duluth (Minn.) station. Had weather conditions permitted an average output at these two establishments, the total distribution for the entire territory would have been close to previous high records.

DULUTH (MINN.) STATION

[WARD A. COOK, Superintendent]

Collecting stations in the Lake Superior field were opened shortly after the middle of September for the reception of eggs from an unusually early run of lake trout and approximately 500,000 were taken before the beginning of the closed season in Michigan waters. From that time on collections were continued under satisfactory conditions until shortly after the middle of October. Beginning October 20 and lasting nearly a week the lake was swept by gales of such intensity as to result in an immense amount of damage to commercial fishing equipment; and, after the winds subsided, it was found that all the lake trout which had congregated on the reefs had left that portion of the lake, thus putting an end to the collecting season. From the 9,357,000 eggs taken, 6,603,500 fry were developed and planted in the Michigan waters of the lake. In addition to 2,060,000 whitefish eggs of poor quality obtained in the vicinity of the Isle Royale fisheries, 3,400,000 green whitefish eggs were turned over to the station by the Michigan Department of Conservation. The two lots yielded approximately 2,800,000 fry, most of which were planted in Isle Royale waters. Cisco eggs to the number of 18,150,000 were received during November in the Bayfield (Wis.) field. A large percentage were inferior, and only 6,200,000 fry were hatched. Practically all of them were planted in the vicinity of Bayfield. Early in the winter the station received by exchange 200,000 eyed brook-trout eggs. From this stock 184,000 No. 1 fingerling fish were produced and distributed to applicants. Egg collections of pike perch were made in Minnesota waters in cooperation with the fisheries department of that State. The results were 10,000,000 eyed eggs from which 9,715,000 fry were hatched and distributed.

NORTHVILLE (MICH.) STATION AND SUBSTATIONS

[W. W. THAYER and FRANK L. SNIPES, Superintendents]

Fish-cultural operations in the Michigan field were on the whole very satisfactory. The aggregate output of the main station and its substations exceeded that of any previous year by 73,537,825. The increase consisted in the main of the larger numbers of whitefish and lake trout produced at the substations.

Northville (Mich.) station.—The output for the year in this field aggregated 1,309,800 fish, with approximately 193,000 rainbow trout and black bass on hand at the close of the year. Two hundred and forty-six thousand brook trout on hand July 1, 1929, were reared to the large fingerling size and distributed in the fall. In the early winter there were received from outside sources 1,282,000 eyed brook-trout eggs. Losses during the incubation and fry periods totaled 521,999, leaving for distribution during the spring 746,100 No. 1 fingerlings. These were used for supplying applicants in the surrounding region and for stocking three cooperative nurseries in Michigan. One hundred and eighty thousand rainbow-trout fry, on hand when the year opened, were distributed shortly afterwards. Eggs of this species numbering 302,000 were received during the year. Seventy-five thousand were reshipped to other stations; the remainder were incubated, producing 227,000 fry of which 51,600 were utilized in filling applications, leaving 143,500 advanced fry on hand at the end of June, 1930. The stock at that time also included 4,500 No. 1 fingerling land-locked salmon. These were the result of 10,000 eggs shipped in from the Craig Brook (Me.) station.

The spawning of 65 smallmouth black bass in one of the station ponds, furnished for distribution 36,000 advanced fry and 59,700 No. 1 fingerlings; and when the year closed there were approximately 35,000 young bass in the pond. One hundred and fifteen adult smallmouth bass received from the Lake Erie field were divided between two ponds, one being 0.52 of an acre in area and the other 0.63. Soon afterwards a number of dead bass were noted in these ponds. Very few nests were observed and neither of the ponds yielded any young fish for distribution. The most important item in the line of improvements during the year was the construction of a modern 8-room cottage for the use of the station fish-culturist.

Charlevoix (Mich.) substation.—A total of 40,218,000 lake trout eggs were handled at this hatchery, with an approximate increase of 30 per cent in

fertilization over that previously attained. Throughout the season test lots of the eggs supplied by various fishermen were kept with the view of determining the quality furnished by each man. The rate of fertilization of eggs from one collecting field, namely, Leland, Mich., was found to run as high as 98 per cent, while those received from other ports ranged from 60 per cent to as low as 7 per cent in fertility. On completion of the tests each fisherman was informed of the results, and it is hoped that all of them will hereafter exercise care in taking the eggs in an effort to furnish spawn of superior quality for the propagation work. For the second time since the work was inaugurated in this field the station batteries were filled to capacity with whitefish eggs; and, after installing all that could be cared for therein, a large excess on hand was transferred to the Alpena hatchery. Incubation was completed at the unusually early period of February 20, and as the lake at that time was filled with ice, the use of cars had to be resorted to for making the distribution. The work was satisfactorily accomplished by means of the bureau's car No. 9 assisted by the Michigan State car "Wolverine." Among the more important improvements during the year were the painting of the hatchery building and the thorough overhauling and cleaning of the filtering plant. Two new fry tanks were built, and at the close of the year the aquaria room was being placed in condition for the maintenance of an exhibit during the summer.

Alpena (Mich.) substation.—Three factors operative in this field, and nullifying to a considerable extent the efforts in connection with the propagation work, were the comparatively poor quality of the whitefish eggs received, unfavorably low water pressure in the hatchery, and an injurious amount of chlorine in the water supply at the time the pike-perch eggs were undergoing incubation. Good weather prevailed at the opening of the whitefish spawning season but unusually severe storms set in soon afterwards, practically wrecking all fishing nets operating in the region. Taken under such conditions the quality of the whitefish eggs could hardly be rated higher than fair. After reaching the eyed stage 2,000,000 of the 71,000,000 secured were forwarded to the Lincoln Park Aquarium at Chicago, Ill. In connection with lake trout propagation, encouraging results were attained in an effort to rear the fry at a nursery located at Rogers City, Mich. An output of No. 2 and No. 3 fingerling lake trout numbering 268,500 and 170,000, respectively, was produced, and at the close of the year 245,000 No. 1 fingerlings were still on hand in the nursery. During April 89,620,000 pike-perch eggs were received from a collecting field operated by the State near Bay City, Mich. They appeared to be of fair quality, but, owing partly to the low-water pressure and partly to the presence of an unusually strong solution of chlorine in the city water supply, the output of fry amounted to only 5,000,000. All of these were planted in adjacent public waters.

Material assistance was received from the Michigan Department of Conservation in connection with the distribution of whitefish and lake trout. As in past years the Detroit & Mackinac Railroad Co. cooperated with the bureau in the carload shipment of fish for planting at various points. The fishermen of the region also rendered valuable aid and hearty cooperation in connection with the distribution and planting of the fish. The fishermen generally are very optimistic concerning the fishing outlook for next year, as great numbers of immature whitefish and lake trout are in evidence. A phenomenal catch of whitefish was made late in June, 1930, one net operating about 6 miles from Epoufette, Mich., taking 3,326 pounds.

PUT IN BAY (OHIO) STATION

[David Davies, Superintendent]

The whitefish spawning season on Lake Erie opened on November 7 and on November 29 was brought to an early and abrupt close by a sudden cold snap which froze the surface of the lake and prevented further operations of the commercial fishing nets. Nothwithstanding the unusually brief egg-collecting period, 71,240,000 were taken, this amount slightly exceeding the take during the fall of 1929. Very satisfactory results were attained in the propagation of pike perch during the spring of 1930. The aggregate egg collection amounted to 316,275,000, being nearly three times the number secured the previous year. Incidental to this work 1,250,000 yellow-perch eggs were taken and incubated. Owing to high-water stages very few carp were taken at the fisheries operated in the Portage River and Sandusky Bay, and while all avail-

able eggs were secured, the season's total amounted to only 3,250,000. During the year needed repairs were made to the station boilers and pumps, and all batteries and steam and water pipes were repaired and painted. The gas boat was overhauled, and painted inside and outside. New furnace lining and boiler fronts were placed on the *Shearwater* boiler, and changes were made on water pipes of deck pump. The hull of the boat was scraped and painted.

CAPE VINCENT (N. Y.) STATION AND SUBSTATIONS

[J. P. SNYDER, Superintendent]

A supply reservoir, 75 by 75 feet in dimensions and 7 feet deep with concrete retaining walls, was completed during the year; and four bass ponds, each exceeding an acre in size, were nearly completed. A new trout nursery consisting of a hatchery, office, meat house, four ponds, and some open-air troughs was constructed during the year near Gracy, N. Y. This establishment is being operated in conjunction with Cornell University management, and in addition to the production of several hundred thousand trout during the year it was used as a base for the conduct of various feeding, rearing, and other experiments under the supervision of Dr. G. C. Embody of the university. In addition to the substations referred to below, the Cape Vincent station supervised the work of cooperative nurseries located at Adams, Malone, Arena, and Oneonta, all in New York State, and at Averill, Vt. The combined output from these projects amounted to 168,120 fingerling and yearling trout, and 228,000 trout of various sizes were in stock at the end of the year.

The unusually small egg collections of commercial species secured for stocking the Cape Vincent hatchery were made under very discouraging conditions. By a decision of the Ontario fisheries authorities the prolific egg-collecting fields along the north shore of Lake Ontario were no longer accessible to the bureau, while unusually severe storms in New York waters of the lake prevented the lifting of nets for a period of 10 days just at the height of the spawning season. This storm period was followed immediately by intense cold, causing all bays to freeze over and necessitating the discontinuance of commercial fishing for the season. In the face of such an outlook whitefish and cisco egg collections were reduced to 1,236,000 and 57,340,000, respectively, while less than 2,000,000 lake trout eggs were taken. During the spring spawning season 6,300,000 pike-perch eggs and 3,000,000 yellow-perch eggs were obtained and incubated. The station received from outside sources the usual number of brook trout, rainbow trout, and Loch Leven trout eggs to cover distribution requirements in New York and adjacent territory.

Watertown (N. Y.) cooperative substation.—The facilities at this substation were improved by the provision of additional hatching troughs and the construction of a cottage. The output consisted of 449,750 trout fingerlings Nos. 2 and 3, and 780,826 trout of different species were being carried in ponds and troughs at the close of the year.

Barneveld (N. Y.) cooperative substation.—As in past years the fish-cultural work at this substation was under the joint supervision of the bureau and the Utica chapter of the Izaak Walton League. Its output of fish consisted of 129,125 brook and rainbow trout of various ages, and 226,389 trout fingerlings and yearlings were on hand as the year closed.

Ithaca (N. Y.) substation.—This project was constructed in the course of the past fiscal year, but it has had no output as yet. On June 30, 1930, there were on hand 194,072 trout of various sizes.

Swanton (Vt.) substation.—The run of pike perch was disappointing and only 63,800,000 eggs of that species were taken. The collections also included 94,380,000 yellow-perch eggs and 6,750,000 of the white sucker, the latter being obtained for the Pennsylvania Fish Commission.

RESCUE OPERATIONS

Water conditions in the upper Mississippi River field were such that the salvage of stranded fishes from the overflowed areas resumed its rôle as one of the most important activities of the La Crosse (Wis.) field headquarters. The work was started during the month

of August and carried on into November, and the total collection of over 146,000,000 fish represents slightly above an average or normal season's work in this field. The seasonal nature of this activity renders it possible for the station's personnel to be utilized in widely varied fields such as the propagation of the commercial species of the Great Lakes and the propagation and distribution of trout in Minnesota and Wisconsin. Cooperative fish-cultural work carried on in conjunction with the sportsmen's organizations in the near-by territory has become one of the most important activities in this field, taking a large number of the output of trout of the La Crosse station and requiring extensive supervision.

LA CROSSE (WIS.) STATION AND SUBSTATIONS

[C. F. CULLER, in charge]

Rescue work on the upper Mississippi River was begun on August 7. Twelve crews were engaged in the work which was terminated on November 19. Over 146,000,000 fish were rescued, of which approximately 490,000 were reserved for distribution elsewhere. The cost of the rescue work was approximately $0.11 per thousand fish handled. In connection with the rescue operations, mussel-infection work was performed and over 1,900,000,000 glochidia were released in a state of parasitism on rescued fishes.

The chief construction work was the erection of dwellings for the district supervisor and superintendent. An artesian well was drilled on the Upper Mississippi Wild Life Refuge grounds adjacent to the station, furnishing a flow of 150 gallons a minute. Trout culture was carried on successfully at the main station, and the Northside station and Lynxville station were operated to care for the overflow. Brook, rainbow, and Loch Leven trout were the species handled. Cooperative rearing ponds supervised by this station numbered 91 in Wisconsin and 24 in Minnesota. Further efforts were made to develop bass-rearing projects. The personnel of the station was detailed to various duties in the field during the year, including the fish-cultural operations in Yellowstone Park, Miles City, Mont., and in Michigan, together with the cooperative work in the State of Arkansas.

Bellevue (Iowa) substation.—A new holding station was constructed here on the property of the Wild Life Refuge, and the water supply was obtained from an artesian well providing a flow of 300 gallons per minute. This furnishes the bureau with a very efficient plant for holding rescued fish prior to distribution. During May and June collections were made of buffalofish eggs and carp eggs. The total collection of rescued fish in this field was 35,614,000.

Marquette (Iowa) substation.—While no construction or other important work was undertaken during the year, successful rescue operations were conducted from this point and over 4,000,000 buffalofish eggs and 3,875,000 eggs of the carp were collected and planted in the Mississippi River. Mussel-infection work was also conducted and 26,835,000 fish were rescued.

Lynxville (Wis.) substation.—During the hatching period for trout this station was used as a temporary holding plant for the surplus from La Crosse. In addition to the ordinary rescue work, collections of brood fish for stocking ponds were made in this field, and from this point aquarium specimens and fishes for scientific investigations were collected and shipped. This is one of the most prolific fields, and the total number of fish handled exceeded 40,000,000, with a considerable number of carp and buffalofish eggs having been fertilized during the spring.

Homer (Minn.) substation.—Fish-cultural work at this point consisted entirely of rescue operations. The station, however, was used as headquarters by the investigating staff conducting biological studies in the Upper Mississippi Wild Life Refuge. It was used, also, for the construction and overhauling of vessels and the overhauling and repair of automotive equipment. One 32-foot launch was constructed at this point, and a smaller boat was built for local use. The total number of fish handled in the rescue work was 22,225,000.

UPPER MISSISSIPPI WILD LIFE AND FISH REFUGE

The following report is submitted covering the biological investigations in the Upper Mississippi Wild Life and Fish Refuge:

Detailed quantitative biological studies of five sloughs in the vicinity of Trempealeau (Wis.) and Winona (Minn.) were made at 2-week intervals throughout the year, summer and winter. Studies were made of bottom and weed fauna populations, plankton, and chemical conditions. These observations in a general way revealed that these sloughs differ widely in production of natural food, that the bottom and weed fauna populations are apparently composed of few species but large numbers of individuals, and that the character of the bottom of a slough can be used in predicting the quantity and diversity of food it contains. Oxygen samples, taken in winter beneath the ice, showed that the oxygen supplies of the sloughs investigated were exhausted by the end of January. This condition would not permit the holding of fish in them through the winter, though river stages would usually permit it. Since all fish landlocked in sloughs are likely to die before the end of January, and since it appears to be impossible to rescue all large fish in them, it would seem advisable to permit early winter fishing in them, provided such fishing would not result in illegal fishing in waters open to the river. Complete analysis of the data collected in these studies will not be possible for several months.

Fish population records of all sloughs seined thus far in our operations show that the pickerel is the most important fish enemy of game fish in the sloughs. Legislation permitting the taking of pickerel 20 inches or more in length by commercial fishermen within the refuge limits would probably result in an increase in the numbers of other species of more desirable game fish.

In fish-cultural practice in the sloughs, screens should be put in and the pickerel removed as soon as the ice goes out in the spring and a favorable river stage permits. Although this was done in the spring of 1930, it probably will not be possible to remove the adult pickerel before they have spawned. In the latter case the seining of the sloughs, which are to be used as rearing ponds for bass, would have to be postponed until just before the bass fry are planted in them.

Examination of river-stage records for this locality shows that the Mississippi River in recent years seldom exceeds the 6-foot stage during the last week in May and throughout June. This will make possible beyond doubt the production of fingerling bass running into the hundreds of thousands in sloughs in this locality, though some years are going to be comparative failures. During the current year 135,000 bass fry were transferred to sloughs prior to June 30. The exprimental results from these plantings will be affected to an uncertain extent, however, by two rises exceeding the 7-foot stage at Trempealeau during the critical period.

Experience during the current year has shown that bass fry less than five-eighths of an inch long apparently exhibit strong negative rheotropism. Losses of fry from our large brood pond were experienced when fry passed through the meshes of the screens (7 meshes to the inch) used to shut the pond off from a slough below connecting it eventually with the river. These losses occurred when the river was dropping rapidly or a current was passing through the pond during high-water periods. Precautions will be taken during another season to place our brood stock in sloughs from which there is no outflow or appreciable passing through.

Experiments in the control of vegetation with sodium arsenite solution were made during the summer of 1929. It was found that amounts of the chemical up to about 1.7 parts per million arsenious oxide could be used with good results without exterminating microscopic or macroscopic fish food organisms. The chemical was applied to the sloughs believed to need treatment early in spring, during a low-water period, before rapid development of vegetation had gotten under way.

In further connection with the bureau's operations a 3½-acre tract in the refuge adjoining the La Crosse hatchery was cleared for the purpose of constructing a bass pond to be supplied with artesian water. A number of inspections were made throughout the refuge for the purpose of locating sites suitable for bass culture, but it was

found that those most satisfactory had not yet been acquired by the Government.

MARINE SPECIES

As has been previously stated a considerable proportion of the increase in the total output of fish and eggs for the fiscal year is attributable to augmented production at the marine stations. Five species only are handled, constituting the forms which are the basis of the most profitable inshore fisheries in the New England area. Changed conditions in the vicinity of the Woods Hole (Mass.) station have rendered it increasingly difficult to obtain a supply of cod eggs, and work at this point was concentrated upon the propagation of the winter flounder. The Gloucester (Mass.) station also had a reduction in its output of cod and haddock, but the work of the Boothbay Harbor hatchery was very successful in all its ramifications.

BOOTHBAY HARBOR (ME.) STATION

[THOMAS H. DOOR, Superintendent]

During that portion of the year when no fish-cultural operations were possible, the station force was employed in making needed repairs to the house occupied by the engineer and other buildings, and in the maintenance of the station aquarium. Two, and frequently three, men with the bureau's launch were engaged in collecting exhibit material; and specimens of every species that could be secured, together with four young seals, were transferred to the station and placed on exhibition in the aquarium and in live cars.

The fish-cultural work consisted as heretofore in capturing brood winter flounder, taking and developing the spawn, liberating the fry, and in stripping, fertilizing, and planting on the natural spawning grounds such cod and haddock eggs as were available at commercial fisheries within reach of the station. With the aid of a temporary force and a chartered power boat to assist the bureau's launch, a total of 96 fyke nets were set in all bays and coves from Johns Bay to Robin Hoods Cove within a radius of 12 miles of the station. At the close of fishing in one place the nets and operations were transferred to another. Working in this way a total of 12,798 brood fish, or 3,000 in excess of the take last year, were captured between March 5 and April 15, and from them 2,625,942,000 eggs were secured and developed, yielding an output of 2,434,538,000 fry for liberation on or near the areas from which the eggs were derived. Work with this species came to an end on April 25. With the opening of the cod season on April 1 a second boat was chartered and, as soon as the winter flounder season had ended, both boats were detailed to the cod work until the height of the collecting season had passed, when the services of one was discontinued. By means of the three boats available all grounds between Pemaquid and Seguin Islands were covered and at the close of operations on May 28 a total of 1,068,142,000 cod eggs and 124,920,000 haddock eggs had been handled. The work with the former species established a record achievement for this station.

GLOUCESTER (MASS.) STATION

[C. G. CORLISS, Superintendent]

This station began active fish-cultural work on November 1 with the acquisition of the first lot of pollock eggs. Collections of these eggs came in at intervals up to the end of January. The total for the season amounted to 1,028,433,000, and from this stock 616,713,000 fry were produced. This output represents a material increase over the results attained in previous years. Of the total collection of 657,722,000 cod eggs secured 307,737,000 were incubated, yielding an output of 229,769,000 fry. The remainder of the collection were planted as green eggs on the fishing grounds, the low density of the water from which they were derived making their transfer to the hatchery impractica-

ble. Haddock fishing on inshore grounds was so poor throughout the spring that only one or two boats were engaged in it. The season's egg collections of this species approximated 135,385,000 of which 38,018,000 were, on account of low water density, deposited as green eggs in the fishing areas where taken. From the eggs handled in the hatchery 63,168,000 fry were developed and planted. Winter flounder operations were conducted between March 4 and April 30. From a brood stock of 350 fish 175,072,000 eggs were produced and 159,972,000 fry hatched and liberated. The offshore operations were prosecuted from February 1 to April 12. During this time 43,106,000 cod and 57,406,000 haddock eggs were handled. These numbers represent a decline as compared with last year's results in this field.

WOODS HOLE (MASS.) STATION

[G. R. Hoffses, Superintendent]

Changing conditions in the local commercial fishery have made it increasingly difficult to obtain cod eggs for incubation. The once prolific collecting fields at Sandwich and Plymouth, Mass., are now entirely closed to such work; and of late years the station has been dependent on the comparatively small local hand-line cod fishery, conducted from small boats manned by one or two men, and two or three traps owned and operated by parties from Newport, R. I. From these sources it is the practice to select such fish as give promise of the greatest egg production and hold them in a pool at the station pending natural spawning. The eggs thus secured are transferred to the hatchery and incubated by the usual method. Experience having shown that fish taken in the traps invariably are superior as prospective spawners to hand-line fish, effects to obtain brood cod are always directed first to the traps. During the past year, however, all traps available in this region took nothing except small immature fish unsuitable for fish-cultural work. From the hand-line fishermen only about 100 cod were collected and nearly all of them proved to be males or barren females. The amount of eggs secured, therefore, was negligible.

The results of the work with winter flounder were entirely satisfactory. Fishing for brood fish of this species continued from January to March and 2,380 females were handled, producing approximately 837,000,000 eggs. The apparently early spawning of winter flounder in Waquoit Bay is mentioned as being of passing interest. The first take of fish in the station nets on January 11 contained spent females. In all previous years all fish taken on or about that time have been held in tanks for a period of one to two weeks awaiting the maturity of their sexual products. During the spring and early summer 17,500,000 mackerel eggs were obtained from the local trap fishery. Scup were also in evidence in the catches, though practically none was in spawning condition. A deaerating device installed in the sea-water tank has proven of real value in reducing the mortality of fish carried for public exhibit or in connection with fish-cultural work.

Offshore spawn-taking operations did not result successfully from the standpoint of eggs fertilized. Being unable to obtain the services of skilled spawn-takers for the work, four inexperienced men from the station personnel were detailed to the offshore field. The experience gained by these men may be of value to the station in connection with next season's operations.

ANADROMOUS SPECIES ATLANTIC COAST

All operations under this classification were materially restricted. The production of shad at the Fort Humphreys (Va.) and Edenton (N. C.) stations was negligible, and no striped bass eggs were obtained at the Weldon (N. C.) substation. The Craig Brook (Me.) station handled 1,000,000 Atlantic salmon eggs secured by exchange but allotted the major portion of them to the State hatcheries where more adequate facilities for rearing the fingerlings were available. The propagation of yellow perch on the Potomac River yielded an output of normal proportions.

FORT HUMPHREYS (VA.) SUBSTATION

[CHARLES W. BURNHAM, Superintendent]

A total of 3,629,000 shad eggs was collected and the 2,120,000 fry produced therefrom were liberated on adjacent spawning grounds in the Potomac River. The shad spawning season of 1930 was one of the poorest ever known for the collection of eggs in this field. A comparatively slight rainfall during the spring caused the river water to become so brackish that hard crabs could be caught in large numbers from the station wharf. Under such conditions the run of shad was necessarily light and only a small proportion of the fish were ripe. From a brood stock of approximately 24,700, yellow-perch eggs to the number of 88,920,000 were secured from which 80,050,000 fry were developed. All of these were planted in the river at points where the brood fish had been taken with the exception of 20,780,000—the latter being used for stocking other waters, chief among them being tributaries of the Potomac. Eggs of the yellow perch are obtained by holding the adult fish in wooden crates in the river until they spawn. The adults are then liberated and the eggs are collected and developed in hatching jars. Any excess eggs left after filling the hatchery to capacity are hatched in wire baskets anchored in the river.

The most important improvement during the year was the installation of electric wiring about the grounds, the wiring of all buildings, and the installation of electric lights therein. This work was completed during the month of March, in advance of the season's fish-cultural operations. For the purpose of holding up the earth embankment, a concrete wall, 3 feet high and 8 inches thick, was built along the walk to the main buildings for a distance of about 300 feet. Considerable work was done on the road leading from the top of a steep hill to the station buildings. A pond fed by water from a small spring was formed by damming a ravine near the superintendent's residence. A lot of brook trout 1½ inches in length were installed in the pond as an experiment. After remaining therein for a period of two months and receiving a regular ration of beef heart they appeared, at the close of the fiscal year, to be in excellent condition.

EDENTON (N. C.) STATION AND SUBSTATION

[WILLIAM S. VINCENT, Superintendent]

The propagation of commercial species was conducted as in former years, but the results were considerably below the average. In the case of the shad this was due partly to scarcity of fish in spawning condition in the single collecting field available for the work and partly to the inferior quality of the eggs secured. A large percentage of the mature females were found to be overripe and, under such conditions, the eggs can not be fertilized. Only about 3,000,000 shad eggs were secured, and all of the fry developed from them were planted in the vicinity of the collecting ground at the mouth of the Chowan River. Continuous adverse winds and cold weather during February prevented a normal collection of brood yellow perch before the spawning season had begun and only about 400 females with eggs could be obtained. These were placed in one of the station ponds to spawn and produced approximately 3,000,000 eggs, the fry from which were utilized for supplying applicants and for the restocking of local public waters. Unripe herring in vast numbers appeared on the fishing grounds near the station some three weeks earlier than usual, the run continuing for over a week. On account of the prevailing low temperatures, however, but few of the fish were in spawning condition, and only 30,000,000 eggs were collected. The 10,000,000 fry produced as a result of the work were planted in local waters.

A decided improvement was effected by the erection of a 6,000-gallon steel water tank on a 12-foot tower for the storage of hatchery water and the demolition of the old wooden tank. The latter had been in service for over 30 years, and on account of its prominent location, it detracted greatly from the general appearance of the station.

Weldon (N. C.) substation.—The striped-bass station at this point was opened on May 1, and placed in condition for active operations. On account of low-water stages in the Roanoke River, however, very little successful fishing was possible and no eggs were available. The station was closed on May 17. The moderate expense incurred in this field was partly defrayed by the North Carolina Department of Conservation, in accordance with the practice of recent years.

CRAIG BROOK (ME.) STATION

[GEORGE N. MONTGOMERY, Superintendent]

In accordance with an existing agreement, this station received 1,000,000 Atlantic salmon eggs from hatcheries under the control of the Canadian Government. Of this stock two consignments of 20,000 eggs were supplied to the States of Pennsylvania and California; 125,000 were transferred to the Grand Lake Stream auxiliary for development, and 715,000 were turned over to hatcheries operated by the State of Maine, with the understanding that the resulting fish would be held and fed for a period of two years and then liberated in waters directly connected with the Atlantic Ocean. The fish developed from eggs retained at the station numbered approximately 90,000 at the close of the year. The station's distributions of this species during 1930 consisted of 106,400 large fingerlings carried over from the hatch of the previous year and liberated during September in tributaries of the Penobscot River. Ninety-seven thousand fingerlings, derived from eggs turned over to the Maine fisheries authorities by the bureau last year, were also liberated from hatcheries operated by the State. As was the case last year, the weir fishermen of the region were interviewed as to the status of the salmon fisheries. All reports received were favorable though the fish were said to be running somewhat small in size. On the whole, salmon fishing on the Penobscot River is considered to be good, though pollution conditions exist that are tending to reduce the number ascending the river each year.

FISHES OF MINOR INTERIOR WATERS

By far the greater proportion of the existing hatchery facilities in this country both State and Federal, is directed toward the propagation of the game and semicommercial species indigenous to the lesser waters of the interior section. It has been clearly demonstrated by private clubs that the continuous restocking of a given body of water with game varieties will assure the perpetuation of first-class angling. The State and Federal hatcheries in distributing trout, bass, and other game forms direct to public applicants, or in making plants from the hatcheries, serve as a basis of supply for restocking strictly public waters in the same manner as privately controlled waters are administered. In view of the increasing tendency of private individuals and organizations to purchase or lease control of desirable fishing waters, the public welfare demands increasing efforts on the part of Government agencies to provide equally good fishing in the lakes and streams which still remain accessible to the public. The problem involved in this work has widely divergent aspects. In the more populous centers the situation has reached a point where practically every fish which is to be caught must be planted from some hatchery, since the factor of natural reproduction is negligible. On the other hand, in the Western States the planting of large numbers of trout is a means of supplementing the natural reproduction and forestalling the depletion which has occurred in other areas. The distribution of the product of a single hatchery over a wide area, sometimes comprising several States, does not permit plants of fish adequate to effect a real improvement at any particular location except in the case of the Southern States, where a newly constructed artificial pond or lake may be supplied with an initial stock. The ideal to be attained and to which progress is constantly being made, is the establishment of a hatchery for each outstanding fishing area or stream system, the output of which is to be devoted to restocking local waters and not distributed over a great expanse of country.

ROCKY MOUNTAIN TROUT STATIONS

The Rocky Mountain stations and their substations have a large capacity for the production of trout and are carrying on field operations which yield large collections of eggs from wild fish annually. The surplus trout eggs so secured are transferred to others of the bureau's stations after the requirements of the parental waters are met. The western trout stations must meet a dual demand since they are called upon for extensive plantings of fish in the public domain, particularly the national forests and national parks, in addition to supplying fish to the individual angler or sportsmen's groups in the usual manner.

BOZEMAN (MONT.) STATION AND SUBSTATIONS

[W. T. THOMPSON, Superintendent]

The Bozeman station and its auxiliaries experienced a very prosperous year and succeeded in establishing a new record in almost every line of endeavor. The total number of eggs handled by this group of stations amounted to 30,675,070. The distribution resulting therefrom numbered 24,558,645, and a total of over 6,000,000 eggs, fry and fingerling fish were on hand at the close of the year.

Bozeman (Mont.) station.—The station enlarged its rearing operations to the extent that 24 carloads of choice fingerling fish were produced for general distribution in addition to the considerable numbers utilized in supplying near-by applicants and making local public plants. No brood stock is maintained at Bozeman. In the course of the year, 1,197,200 rainbow trout eggs and 10,256,550 Loch Leven trout eggs were transferred there from the Meadow Creek (Mont.) field, largely for the purpose of eying and shipping on assignment. There were also received from other stations of the bureau 550,000 fall-taken Missouri rainbow eggs, 49,020 black-spotted trout eggs from domesticated stock reared at Pittsford, Vt., 573,000 black-spotted trout eggs from wild fish of the Yellowstone Park, and 132,000 brook-trout eggs from Springville, Utah, making a total of 1,304,020 eggs obtained by transfer from outside stations. There were also received through the medium of exchange 109,000 rainbow-trout eggs, 2,474,900 black-spotted trout eggs from the Montana Department of Fish and Game, and 10,000 golden-trout eggs from the California Fish and Game Commission. The above made a total of 2,593,900 eggs received by exchange and a grand total of 15,351,670 derived from all sources.

The station continued its experimental work in the feeding of liver-meat meal, prepared from horse flesh, to young fish in hatchery troughs, and the value of this material for the rearing of trout up to the No. 3 fingerling stage was successfully demonstrated. It is considered that the station's greatest contribution to fish-cultural information during the year was the success attending its experimental work for the purpose of ascertaining the proper water temperature and other conditions requisite for the production of choice Loch Leven trout fingerlings. This problem has now been largely solved. As in the past, harmonious relations were maintained with the Montana Fish and Game Commission. In the course of the year that organization supplied green eggs to the Meadow Creek substation. These were incubated and reared to the planting stage and then planted in suitable State waters in cooperation with the State officials.

Meadow Creek (Mont.) substation.—At this point record collections of rainbow trout and Loch Leven trout eggs were made, the numbers amounting to 4,120,800 and 18,379,400, respectively. An initial collection of 44,000 black-spotted trout eggs was made as a result of recent development efforts. A total of 1,617,200 rainbow eggs were transferred to Bozeman and Glacier Park and 600,000 were shipped on assignment—all being reported as received in excellent condition. Fingerling rainbows to the number of 1,183,400 were planted in Madison Valley waters, and 1,051,400 remained on hand at the

end of the year. Loch Leven trout eggs to a total of 10,256,500 were transferred to the Bozeman field, 4,007,100 were shipped to applicants, 3,676,200 fry and fingerling fish were planted in Madison Valley waters, and at the end of June, 1930, 50,000 fingerlings were on hand at the station. The total of the above shows an output of 95½ per cent of the eggs collected.

Glacier Park (Mont.) substation.—From the hatchery in this field 391,700 rainbow and 802,150 black-spotted trout fingerlings, together with 70,500 fry and 51,000 eggs of the latter species, were delivered to the Glacier National Park Service for planting in national park waters. The eyed eggs were utilized for stocking distant virgin lakes difficult of access. Forty-four thousand eight hundred golden-trout eggs, received through the courtesy of the California Fish and Game Commission, were planted in Lake Wurdeman near the Canadian border. In addition to the above there remained in hatchery troughs and ponds at the close of the year 476,380 rainbow fry and 994,320 black-spotted trout eggs. The facilities at this substation were increased during the year by the completion of eight large rearing ponds and the construction and installation of a new battery of troughs. A new water supply was also provided.

FIGURE 2.—Taking trout eggs at a field egg-collection station

Miles City (Mont.) substation.—This new substation was operated in conjunction with the Montana Fish and Game Commission on an equal share basis. The results were very encouraging notwithstanding the unsatisfactory conditions brought about by the long spell of hot dry weather, which lowered the water level of the lake to such an extent that less than one-half its feeding area was available at the time when it was most needed. The output from this field comprised a total of 274,025 largemouth black bass, crappie, sunfish, and perch. The harvesting of the fish was rendered difficult by the fact that the middle portion of the lake could not be drained thoroughly, thus entailing a considerable amount of seining which had not been contemplated. In cooperation with the Montana commission, a residence for the caretaker, a large tank and sorting house, and a small garage were constructed after the close of the distribution season. A supply ditch was excavated and an independent pumping plant was arranged. With the view of making this substation a complete and independent pond unit capable of furnishing for car distribution all varieties of the pondfishes ordinarily desired, it is planned to construct an additional lake of smaller size than the one now in use for the production of such species as catfish and yellow perch.

LEADVILLE (COLO.) STATION AND SUBSTATION

[C. H. Van Atta, Superintendent]

A lumber shed 20 by 36 feet in dimensions was built for the storage and seasoning of green lumber sawed by the station mill. Double doors were made for the 7-stall station garage, and doors for the garage at the Creede substation were built here. All necessary repairs were made on the station buildings and grounds. The drainage ditch back of the hatchery was widened and deepened throughout a distance of 500 feet. A new electric generator was purchased for the station lighting plant and put in operation. Eyed rainbow-trout eggs numbering 484,570 were received from Seattle, Wash., in exchange for brook-trout eggs and 150,400 eyed black-spotted trout eggs were transferred to this point from the Yellowstone Park. The year's output of fish, comprising 3,575,500 brook trout, 459,500 rainbow trout, 65,800 black-spotted trout, and 102,000 Loch Leven trout, was distributed by means of the bureau's car No. 8. The usual brook-trout egg-collecting stations were operated at the Mount Massive Club Lakes, Turquoise Lake, and Wurts Lakes in accordance with the percentage basis formerly agreed upon, and a total of 3,756,000 eggs were taken. On attaining the eyed stage 100,000 of these were shipped, and from the remaining stock 3,369,800 fry were hatched. About 1 acre of mud and silt was removed from Crystal Lake during the fall of 1929.

Creede (Colo.) substation.—The work of constructing this substation was undertaken in September, 1929. By November 22 the hatchery was put in operation, and in the course of the fiscal year a garage and carpenter shop were completed, the foreman's cottage inclosed, a road built from State highway No. 149 to the hatchery, and the hatchery water supply was placed in readiness for fish-cultural work. Brook-trout eggs to the number of 1,039,000 were received from a private hatchery and from Mason Lakes, Colo., to be developed on a percentage basis. From this stock 841,000 fish were hatched and 608,360 were distributed by the station truck before the end of the year. Eagle Nest Lake, N. Mex., and the Trinchera and Continental Reservoirs, in Colorado, were worked during the spring of 1930 for eggs of the rainbow and black-spotted trout. A total of 1,064,000 rainbow eggs were collected at Eagle Nest Lake and Trinchera Reservoir, and 854,600 eggs of the black-spotted trout were secured from the Continental Reservoir.

YELLOWSTONE NATIONAL PARK (WYO.) SUBSTATION

[C. F. Culler, in charge]

Field operations at the Yellowstone Park substation overlapped two fiscal years, and the data herein supplied cover the summer season of 1929, or parts of the fiscal years 1929 and 1930. Collections of black-spotted trout eggs at this point numbered 18,871,000 during the fiscal year, and for the entire season, 14,656,000. As usual the personnel was recruited by detail from other stations. The cost of producing eggs was $0.138 per thousand for green eggs and $0.153 per thousand for eyed eggs.

A hatchery building containing an aquarium, with seven large exhibition tanks, was virtually completed. A mess hall was also constructed and work was inaugurated on a dormitory building. All buildings are of rustic log frame construction in harmony with the surroundings and the general style of architecture in the park. Necessary changes in the hatchery water supply were also made to accommodate the new building. One new motor boat was supplied. Experiments were made with an iron fish rack designed to overcome the difficulties arising from the common wooden racks being frequently washed out by high water in the streams. A new section was built on to the hatchery dock.

The first eggs were secured on June 7, and unusual conditions tended to restrict the collections somewhat below previous records. The streams rose during the first few days in June and thereafter failed to reach the normal or average flow. The lake was, likewise, some 20 inches below its normal summer height. While collections were more limited, the percentage of fertility was high, being over 96 per cent. Four ponds were used for rearing black-spotted trout to fingerling size at the hatchery, and the rearing ponds at Mammoth Hot Springs were stocked with rainbow, Loch Leven, and brook trout from the Bozeman (Mont.) station. During August excessive mortality

developed and, on the failure of remedial measures, the surviving fish were distributed. The rearing ponds were also stocked with black-spotted trout fry which will be held for later distribution.

Reports again show extensive damage to fish traps and other property by bears. The destruction of the fish traps generally results in a loss of fish, since the bears are seeking them for food.

Experiments were made with the use of Great Lakes trap nets for the capture of adult trout near the outlet of the lake. A large number of fish were taken, but the work was initiated too late in the season to bring about the most effective results.

SARATOGA (WYO.) STATION

[S. M. AINSWORTH, Superintendent]

Using material purchased during the fiscal year 1929, a new nursery building 34 by 50 feet in dimensions was erected, thus increasing the station's hatching capacity from 36 to 101 troughs. A retaining wall was built along the earth bank ponds to prevent washouts and possible damage from burrowing animals. The electric-power line from the town of Saratoga, completed

FIGURE 3.—Setting trap nets to capture black-spotted trout for the collection of eggs. Yellowstone Park

and put in operation at the beginning of the year, is giving very satisfactory service. Completion of the work of painting all station buildings was accomplished in the summer of 1929. The collection of brook-trout eggs in the Big Creek Lakes field was far below normal, and, as their quality was somewhat inferior, the deficiency in stock was made up by the transfer of 557,000 eggs of excellent quality from the Springville (Utah) station. One hundred thousand No. 1½ fingerlings of this species were distributed during the spring and 500,000 fingerlings were on hand when the year closed. From the station brood stock of Loch Leven trout, 465,000 eggs were secured from which 420,000 fry were hatched. This lot of fish in the fingerling stage was carried over the end of the year.

The rainbow-trout egg collection in the Lost Creek field was below normal on account of low-water stages. In some of the streams there was not sufficient water to enable the fish to ascend to the traps and in such cases seining had to be resorted to at the mouths of the streams. The fish were larger than the average size and yielded more than the usual number of eggs per fish. Of the 1,709,000 collected, 409,000 were set aside to be hatched with the view of returning the product to their native waters. On reaching the eyed stage 247,000 of the remaining stock were transferred to the Saratoga hatchery and 657,000 were shipped to other stations. In connection with future operations in this field it is hoped to overcome the heavy losses of

eggs which annually occur under present conditions by the improvement of a small spring near the hatchery for the development of eggs taken during the latter part of the season. By carrying out this plan the use of water which has seeped back into Lost Creek from irrigated meadows, where it has absorbed a large percentage of alkali, can be discontinued. The output of the station also included 440,000 black-spotted trout fingerlings—the result of eggs of that species furnished the station from Nevada and the Yellowstone Park field.

SPEARFISH (S. DAK.) STATION AND SUBSTATION

[D. C. Booth, Superintendent]

The large stock (upward of 600,000) of fingerling brook, Lock Leven, and rainbow trout on hand at the opening of the year was held in troughs and station nursery ponds until fall, and then given a wide distribution as Nos. 3 and 5 fingerlings. Nearly 1,400 transportation cans were required for the movement of these fish. Of course it would be possible to greatly increase the number of game trout distributed by making all shipments in April or early May, but it is believed that the results of distributing large fingerlings are of far greater value to the waters stocked. The holding and rearing of this large number of young trout was made possible by the recent installation of the wood-stave pipe line. During the year one of the larger ponds was subdivided into five very useful nursery ponds averaging 60 feet in length, 10 feet in width, and over 3 feet in depth. The bottoms of these ponds are of earth and the division walls, sides, and ends are of reinforced concrete. Each pond is provided with several inlets and outlets in the ends and sides, thus insuring a satisfactory water circulation. Young trout were placed in all these ponds in April, and by the close of the fiscal year only nominal losses had occurred.

Among other station improvements a bridge with concrete walls was built across a large storm channel, and wide concrete walks and a concrete roadway were constructed in front of the main fisheries building. For the first three years after this station was established an abundant supply of spring water was available, but the supply has since declined and, were it not for its high quality and low even temperature, it would not be possible to turn out the station's average of strong healthy trout. The maximum temperature of the spring water in the hatching troughs is 48° F., while the minimum averages 44° F. throughout cold winter periods. This low maximum may not be conducive to rapid growth, but there is no question that it produces strong healthy fish for distribution, and the troublesome diseases experienced at other stations are an unimportant factor at Spearfish station. The nursery ponds have a dual water supply with part of it being taken from the river and part from the cold spring. By such an arrangement the pond temperature usually ranges around 54° F., making possible a very satisfactory growth of fish. During the year considerable assistance was rendered to clubs, commercial fish-culturists, and individuals by solving complicated fish-cultural problems. Such assistance was given both personally and by correspondence.

Over 2,000,000 brook, Loch Leven, and rainbow trout eggs, obtained largely from station brood stock, were handled in the course of the year with merely nominal losses. Approximately two-thirds of a million eggs were secured from brood rainbow trout held at the station. Of these, 185,000 were assigned to the substation at Crawford, Nebr., and others were given in exchange for eyed brook-trout eggs for the Spearfish and La Crosse stations. A shipment of Loch Leven trout eggs was received from the Bozeman station and during January 400,000 brook-trout eggs were received by exchange. At the close of the year over three-fourths of a million brook, rainbow, and Loch Leven trout were being carried in station nursery ponds for late fall distribution as Nos. 4 and 5 fingerlings.

Crawford (Nebr.) substation.—Construction work connected with the establishment and development of this auxiliary was in progress throughout the year. A 1-story frame cottage, for the occupancy of the apprentice fish-culturist was built. The hatchery building was completed, troughs installed therein, and a supply of trout eggs was incubated during the winter. Work was started on the repair of Grabel Dam. The spillway was cut on the south side, cement side walls put in, and some work preliminary to the installation of a standpipe was accomplished. The ice pond dam, damaged by a recent flood, was repaired and the pond stocked with rainbow trout. At the close of

the year a survey for a pipe line from springs at the pumping plant on the military reservation to the hatchery was being made, with the view of obtaining an auxiliary water supply for tempering the city water, which is too warm for trout in summer and so cold in winter as to retard the development of the eggs beyond the period where strong healthy fish are possible. In the course of the year the station received by transfer from other bureau stations approximately 170,000 eggs of the rainbow trout and 250,000 of the Loch Leven trout. In addition to this stock 200,000 brook-trout eggs were derived from a commercial hatchery. All of these were incubated and the fish reared to the fingerling stage before distributing them to applicants of the region. The year's output also included over 150,000 bream and smaller numbers of yellow perch and catfish, these fish having been collected from ponds in the vicinity.

SPRINGVILLE (UTAH) STATION

[CLAUDIUS WALLICH, Superintendent]

The following statement summarizes the fish-cultural achievements of this station during the fiscal year 1930 as compared with those of the preceding year:

	1930	1929
Egg collections	6,910,000	3,690,000
Egg shipments	1,797,000	364,400
Distribution of fingerling fish	1,622,000	1,407,100
Stock on hand at close of fiscal year	1,569,000	847,000

The rainbow trout work with station brood stock exceeded that of any former year in that 2,827,000 eggs of fine quality were taken. Egg collections at Fish Lake were 2,762,000 of the brook trout and 1,071,000 of the rainbow trout. Loch Leven trout eggs to the number of 374,000 were received from the Bozeman (Mont.) station of which amount 270,000 were turned over to the Utah Fish and Game Commission. At Pyramid Lake, Nev., 250,000 black-spotted trout eggs were taken. Eighty thousand of the 130.000 eyed eggs resulting from this collection are being reared at Springville and 50,000 at the Verdi, Nev., hatchery with the intention of returning the entire product to the Nevada lake next winter. Material assistance in the distribution of fingerling fish was received from the Utah Fish and Game Commission by placing at the disposal of the station the State's large fish tank truck. This was used in making four trips to Fish Lake, carrying from 125 to 150 quarts of solid fish on each trip, or a total of nearly 500,000 brook trout fingerlings Nos. 2 and 3 for return to the lake. The work at Pyramid Lake, Nev., hampered in its early stages by the hostility of resident Indians, was finally gotten underway with their tacit approval, and it is believed that continued sincere endeavors by the bureau to better fish life conditions at the lake will result finally in the development of an important egg-collecting field. The newly constructed concrete tank nursery was covered with a composition roof and equipped with dams, screens, etc. This nursery contains 96 tanks each 2½ by 2½ by 16 feet and is proving to be a most efficient acquisition. The additional water secured via the highway conduit from the east side also gives a much needed increase in the pond system supply.

NEW ENGLAND TROUT STATIONS

With the exception of the Nashua (N. H.) establishment all hatcheries in this group enjoyed a very successful season. The actual numerical output of trout in this field is much below that of the Western stations, but a larger proportion of the fish are distributed as good sized fingerlings to meet the special demands arising in this territory.

BERKSHIRE (MASS.) TROUT HATCHERY

[E. P. THOMPSON, Acting Superintendent]

Five wells and five well points were driven during the year, increasing the station's water supply by 84 gallons per minute. Both hatcheries, the garage,

and the icehouse were painted on the outside, and the interior of the upper hatchery was given two coats. A new cement floor and 2 new cypress troughs were installed. Needed minor repairs were made to buildings and equipment, and electric lights were provided for in the fish-culturist's cottage. The station brood stock of brook trout yielded 700,000 eggs. Of these 250,000 were transferred to the Cape Vincent (N. Y.) station and from the remainder 340,915 young fish were hatched and reared to the fingerling stage with a merely nominal loss. The year's distributions included 318,000 brook-trout fingerlings and yearlings, 16,095 rainbow-trout fingerlings, 600 yearling catfish, and 400 yearling pickerel. At the end of June, 1930, there were being held for later distribution 78,180 brook trout, 200 catfish fingerlings, and 2,500 smallmouth black bass fry. Eighty-one thousand five hundred of the brook trout distributed were furnished for cooperative nursery work.

CRAIG BROOK (ME.) STATION AND SUBSTATION

[GEORGE N. MONTGOMERY, Superintendent]

In addition to the collection of 2,421,450 brook-trout eggs from station brood fish, the Craig Brook station handled 180,000 eyed eggs of this species received through an exchange. Of the collected stock 975,000 eggs were shipped in the eyed stage to other stations of the bureau, and upward of 1,150,000 young fish were produced for distribution, this number including 351,850 large sized fingerlings carried over from the hatch of the previous year. At the end of June, 1930, 251,620 brook trout and 73,960 landlocked-salmon fingerlings were being carried in rearing ponds for distribution later in the season. This station is now in a position to produce all the brook-trout eggs necessary to meet its own needs besides supplying a reasonable quantity to cover outside requirements.

Grand Lake Stream (Me.) substation.—At the opening of the year approximately 490,000 fingerling landlocked salmon were being carried in rearing ponds. About 69,000 were liberated early in the feeding season to relieve crowded conditions and the remainder were distributed in September as fingerlings No. 3. Out of a collection of 592,970 eggs of this species obtained from local waters in November 120,000 were shipped in the eyed stage to applicants and 200,000 were transferred to the main station. The remaining stock produced 144,220 healthy fry. A few of these were distributed as fingerlings No. 1½ early in June and approximately 114,550 were being reared at the close of the year. Brook-trout fry to the number of 98,635 were derived from a consignment of 100,000 eggs transferred from the main station. Thirty thousand were distributed as fingerlings in May and June and the remainder were on hand at the close of the year. From a lot of 125,000 eyed Atlantic salmon eggs received from Craig Brook station in March 121,300 fry were developed. At the end of the year this entire lot were being held in the station ponds and fed.

In the course of the year needed repairs were made to racks and bulkheads and the bottoms of all ponds were newly sanded and graveled. Enough firewood was cut, hauled, and sawed to properly supply the hatchery and office needs. Stumpage was charged at the rate of $1.50 a cord.

ST. JOHNSBURY (VT.) STATION AND SUBSTATION

[A. H. DINSMORE, Superintendent]

Brook-trout eggs to the number of 994,764 transferred to this station from the York Pond (N. H.) auxiliary, 300,000 turned over to the station by sportsmen's organizations, and 556,609 purchased from commercial firms constituted the source from which the station's stock of brook-trout fry was derived for the usual distributions during the month of May. The entire output, consisting of 1,637,000 young fish, was distributed either by means of the station truck or by private cars whose owners called at the hatchery to receive their consignments. Extensive repairs were made on the superintendent's residence and the station power house during the year.

York Pond (N. H.) substation.—At this auxiliary, operated especially for egg production, 5,482,390 brook-trout eggs were taken. Of this stock 3,294,764 eggs were shipped to other stations of the bureau and approximately 750,000 were retained at the station for incubation. Shipments of fish resulting from

these eggs to the amount of 345,053 were planted in local waters prior to the absorption of the sac, and the remainder were reared with the view of selecting the best among them for use as a future brood stock. At the close of the year the records showed 233,307 fingerling fish on hand, many of which were approaching the No. 3 fingerling size. This is by far the best record that the station has made.

Work along the line of improving and developing the station was prosecuted whenever fish-cultural operations would permit. Such development work consisted largely in the extension of the canal and pond system. A diversion dam and extensive flood spillway were constructed along the main West Branch and the canal way for approximately 1,000 feet to the valley of Diversion Brook; and during the winter, after the supply of wood for fuel was cut, cement material for the intake was hauled to the canal way and a considerable amount of grading was accomplished. Improvements to station buildings were continued and extensive repairs were made on the station power plant, iron buckets being installed in the water wheel and the dynamo practically rebuilt. In the course of the year two large ponds were completed, partially flooded, and put in commission for the retention of brood stock.

PITTSFORD (VT.) STATION

[Dr. H. S. Davis, Director; R. F. Lord, in charge]

A considerable portion of the time was spent in providing facilities for holding an increased stock of fingerling and adult trout. Six additional ponds and another 12-compartment raceway unit for experimental work were completed. Two of the fingerling ponds are of the circular type, insuring an efficient water circulation and a uniform distribution of the fish throughout the pond area. Arrangements were also made to lease additional land, which will permit of the construction of six small spring-water ponds for the wintering of fingerling fish. The general experimental work in relation to trout foods, selective breeding, etc., was very successful. One series of feeding experiments was completed in September, 1929, and another started in the succeeding April.

There being an insufficient surplus of brook-trout fingerlings to permit of a distribution in the fall of 1929, the plantings were confined to the liberation of larger fish. Among them were 450 tagged rainbow and steelhead trout from 1 to 3 pounds in weight. These were deposited in Vermont waters and reports on them have been coming in since the opening of the fishing season on the first of May. The liberations also included 675 brook-trout yearlings 6 inches in length and one hundred and sixty 2-year old brook trout averaging a pound or more in weight. The only fingerlings available for the fall distribution were two small lots of landlocked salmon and rainbow trout. The spawning of the station brood stock of brook trout began October 29 and additional eggs were taken to December 11, inclusive. For the first time since the station was operated it was unnecessary to secure eggs of this species from other sources. A sufficient number of eggs were taken to more than serve experimental needs and shipments both of eyed eggs and advanced fry or small fingerlings to a total of about 280,000 were transferred to other stations. In addition to the general spawning 55 pairs of selected brook trout were stripped and eggs kept in individual lots. The best record made by this stock was in the case of one lot that finished the fiscal year with a loss of only 9 per cent from the green-egg stage. Only the best of these lots will be retained for a future brood stock.

About the middle of December approximately 15,000 eggs were secured from a selected stock of rainbow trout reared from spawn produced at the White Sulphur Springs (W. Va.) station. Black-spotted trout, hatched from Yellowstone Park eggs in 1926, were stripped for the first time on April 15 and yielded eggs of exceptionally fine quality. Montana grayling, hatched in July, 1929, were successfully carried through the winter and by the close of the fiscal year some of them had attained a length of 6 inches. Experimental lots of rainbow trout and steelhead began spawning in April but their eggs were decidedly inferior to those secured from the black-spotted trout. In cooperation with the Vermont Department of Fish and Game, planting experiments involving both the grayling and the black-spotted trout will be instituted in the near future.

NASHUA (N. H.) STATION

[James D. DeRocher, Superintendent]

No important construction work was carried on during the year.

The station was supplied with brook-trout eggs from the collections of brood stock and by transfers from other stations, together with the purchase of eggs and fry from commercial hatcheries. A heavy loss was experienced with the brook trout from practically all lots during the fry stage. On July 1, 1929, 232,000 fingerlings were on hand, and all were distributed during the year with the exception of 5,000 retained as yearlings. At the opening of the year there were small lots of rainbow-trout and landlocked-salmon fingerlings, which were also distributed. Small collections of smallmouth bass fry and bullhead catfish were made from near-by waters for distribution. The total distribution of all species was in excess of 315,000, with 210,000 remaining on hand at the close of the year. In addition to the ordinary station work there were established five cooperative rearing plants with fish and game clubs, which were supplied with a total of 105,000 brook-trout fingerlings. While the distribution from these nurseries was not all that could be desired, it was considered satisfactory for the first year's work.

COMBINATION TROUT AND POND STATIONS

While five hatcheries have facilities for propagating both the trout and warm-water fish, in almost all cases the greatest production is attained with the former and the output of bass, sunfish, crappie, etc., is largely in the nature of a by-product derived from an additional utilization of the water supply after it has served its purpose for the propagation of trout. It is quite evident that the successful culture of pondfish must be carried on at a station specifically designed for that purpose, but in view of the overlap of the habitat of the cold water and warm water varieties, in many cases the dual capacities of these stations serve an admirable purpose.

ERWIN (TENN.) STATION

[A. G. Keesecker, Superintendent]

A driveway was constructed from the hatchery to the new paved highway that passes through the station grounds. After grading the new road it was given a covering of railroad coal cinders. A new roof was installed on the office building, this job requiring an entire sheathing over the main building and the surrounding porches. The grounds were improved and protected by building a concrete and gravel walk from the spring to the foreman's cottage and constructing a fence along the new highway. The pond system was repaired by removing approximately 15,000 cubic feet of mud from the supply canal on the lower grounds and 1,000 cubic feet from five of the ponds. In making the fills necessary for the roadway 1,000 feet of earth were required. This was obtained by excavating a sufficiently large space in the bank for the building of a commodious storeroom or a garage. This space was lined with a concrete wall built on three sides, and it is expected to complete it at an early date.

Between November 25 and February 25 eggs to the number of 797,722 were taken from the station brood stock of rainbow trout. These eggs proved of inferior quality and did not produce a satisfactory output of fry. Four hundred thousand brook trout received by transfer were handled, and 50,000 of the same species were incubated for private parties. The output of fish of all species was somewhat smaller than that of the preceding year. The warm-water fishes were produced in about the usual numbers. The station cooperated with the Wytheville (Va.) station by furnishing it with fingerling rainbow trout. Supplies of tadpoles were also collected and forwarded for the work of the Chemical Warfare Service.

MANCHESTER (IOWA) STATION

[G. H. GILL, Superintendent]

In the course of the year the interior of the hatchery and the rearing room were given two coats of flat-tone paint throughout. Four of the other buildings were painted outside and two of them were reshingled. New wooden supports were installed for 64 metal troughs and the new Clark-Williamson trough. A cement water tank or cistern of 4,000-gallons capacity was constructed on a high point east of the hatchery. The old boiler was dismantled and a new 6-section low pressure steam boiler installed. Approximately 60 cubic yards of clay were hauled for the bottom of the new bass pond. One million eight hundred thousand rainbow-trout eggs of good quality were obtained from the station brood stock and handled in conjunction with 624,800 brook trout eggs received from outside sources. A fair rating was attained in the hatching and distribution of the product of these eggs and at the close of the year 50,000 rainbow and 130,000 brook trout fingerlings were on hand awaiting later shipment. All fingerling trout, both brook and rainbow, were entirely free from disease and made an excellent growth, but all of the brood trout, including yearling and 2-year-old stock, were seriously affected with gyrodactylus and considerable losses resulted. Unseasonably cold weather during the spring injured the eggs of the smallmouth black bass but there are indications that the output of rock bass will be good.

NEOSHO (MO.) STATION AND SUBSTATION

[W. H. THOMAS, Superintendent]

Having undergone a rather thorough restoration within the past two years, the stations in this field are all in good condition with the exception that the severe cold of the past winter caused the breaking of several of the pond walls. This damage will have to be repaired during the coming year. Notwithstanding the loss of approximately one-fourth of the brood stock of rainbow trout at the Bourbon substation in August, 1929, the results of the propagation work with this species during the year were somewhat in excess of those attained in any previous year. Although the parasite gyrodactylus manifested its presence among the stock of trout, no undue loss of fish was experienced. Approximately 3,500,000 eyed rainbow trout eggs were supplied to applicants, the shipments going east to New York, west to Montana, and also into South Dakota and North Carolina. The fingerling and adult rainbow-trout distribution amounted to 101,000. The combined weight of the latter aggregated 3 tons, and owing to their large size they could be delivered only for local streams. A very successful year was experienced in the propagation of the pond-fishes. Fertilizer was used freely in the ponds and daphnia cultures introduced therein from time to time, greatly promoting the growth of the fish. The year's distribution of bass, crappie, bluegills, etc., was slightly more than 303,000 and exceeded the record of any previous year.

Bourbon (Mo.) substation.—The work at this station is conducted cooperatively with the owners of the property, and its main purpose is the production of rainbow-trout spawn. The fingerling fish resulting from the work are either retained for brood stock or given to the guests of the owners of the property. The rainbow-trout spawn collected during the year was of the highest quality, comparable in a measure to the eggs of wild trout, and all fingerlings carried were maintained throughout the season in excellent condition. The adult rainbows were fed on a ration consisting of two parts horse flesh, one part sheep liver, with a 30 per cent addition of middlings in the form of a mush. The collections of eggs at this substation have increased steadily in volume within the past few years and their quality during the past year was higher than has ever before been experienced here.

Langdon (Kans.) substation.—Owing to the severe drouth prevailing in this region the collection of pond fishes did not equal those of the preceding year, though they were larger than the take of any year before that one. The output included black bass, crappie, bluegills, etc., with black bass making up more than one-half the total.

WHITE SULPHUR SPRINGS (W. VA.) STATION

[EDWARD M. HAYNES, Superintendent]

While fewer trout eggs were handled than in the preceding year, the results of the work at this station are regarded as satisfactory. The total output of all species, including both fish and eggs, amounted to 3,380,826. Owing to a curtailment of the rainbow-trout work the station was not in a position to ship the usual number of eyed eggs. Notwithstanding this fact the output of fingerling rainbows was larger than heretofore and they were fish ranging from 2-inch fingerlings to the yearling size. At the beginning of the year 42,500 fingerling trout were on hand. Three hundred and fifteen thousand Loch Leven and 1,435,000 rainbow trout eggs were taken during the spawning season. To the eggs of the former were added 375,000 received from the Bozeman (Mont.) station and from the combined stock 463,200 fingerling Loch Levens of decidedly fine quality were produced and distributed. Distribution in the eyed stage absorbed 515,950 of the rainbow trout eggs. All the shipments were consigned to various points in the United States with the exception of one to South America. From the eggs of this species retained, 426,904 large fingerling fish were produced. The station received by exchange 2,510,000 brook trout eggs and developed from them 1,974,667 fine fingerling fish of which 15,000 were on hand at the end of the year.

Cooperative relations were maintained with the West Virginia Game and Fish Commission and the Virginia fisheries authorities. Such work for the State of West Virginia included the incubation of 1,200,000 brook trout eggs. and fingerling trout to the number of 110,300 were furnished for stocking nurseries established and operated by the State of Virginia.

Fish of the warm-water species were produced in about the usual numbers. The customary handicap of unfavorable weather was operative, and an abnormal loss of eggs occurred as the result of extreme temperature fluctuations during the spawning season. The output of fish of this class included 10,006 bream, 5,200 rock bass, and 12,700 black bass, all fingerlings. No new construction work was in progress during the year but everything was maintained in good repair.

WYTHEVILLE (VA.) STATION

[CHARLES B. GRATER, Superintendent]

While no construction work of a major nature was undertaken, the routine repairs and maintenance necessary for the upkeep of the plant were attended to by the station force. The entrance road was widened, and a cement retaining wall on the south side of the road was constructed for about three-quarters of its ultimate length. Collections of rainbow trout eggs from the station brood stock amounted to over 550,000, which was considerably below the quantity expected. This situation is ascribed to the fact that the eggs from which these fish were hatched, were obtained from Western stock and were not acclimated. The Craig Brook (Me.) station supplied 400,000 brook trout eggs but the lot suffered a fairly heavy loss in the fry and early fingerling stages. Under a plan inaugurated the previous year the State of Virginia operated three cooperative nurseries stocked with brook and rainbow trout fingerlings from this station. The distribution from the supply furnished the previous spring was unsatisfactory as heavy losses were experienced. These nurseries were stocked with above 180,000 rainbow and brook trout from Wytheville in the spring of 1930 and they were being fed at the close of the year. The station also cooperated with three private nurseries by supplying the fish.

The fall distribution of bass fingerlings of both the largemouth and smallmouth species was negligible owing to the severe cold weather during the spawning season the previous spring. A satisfactory distribution of rock bass and sunfish was obtained.

Further attention was given to the rearing of daphnia as a food for bass fry, and the utilization of these organisms was effective in producing bass fingerlings of a uniform size.

POND FISH STATIONS

The strictly pond fish hatcheries are located in the South and Southwest. The production of fish at a unit of this character is strictly dependent upon the water acreage, and every effort is being made to increase this water acreage while at the same time applying the methods of intensive fish culture to secure an augmented production of fish from the existing acreage. Owing to the fact that in most cases topographical conditions or a shortage of water supply definitely circumscribe the possibilities of expansion and make it necessary to establish substations, additional facilities must be created by the development of projects such as the Valdosta (Ga.) and Fort Worth (Tex.) auxiliaries.

COLD SPRING (GA.) STATION AND SUBSTATIONS

[CHARLES A. BULLOCK, Superintendent]

The dimensions of one large pond were increased about one-eighth, the shallow side of another was deepened to permit of a 1-foot lowering of the water level at overflow, and all new banks were seeded with grass. The swampy basin between Cold Spring and the highway was filled in to a depth of from 2 to 3 feet, and shade trees set out to form a small park. One-half the fish-culturist's cottage was reshingled. With the exception of three, which were used for the propagation of bluegill, bream, and speckled catfish, all station ponds were stocked during the spring with largemouth black bass. During April, May, and June all ponds were fertilized, at intervals of two weeks, with a mixture of superphosphate; but the results of such treatment did not appear to be beneficial. The output of the station ponds for the year consisted of 426,600 bass, 73,835 bream, and 3,825 catfish.

Harris Ponds (Ga.) substation.—These ponds were stocked with small brood bream in April, 1929. No artificial food was given the fish until July 1, after which they were fed daily until October on a mixture of fish meal and shorts. Shortly after the 1st of October the ponds were drawn down and all the fish transferred to the Cold Spring station. From this point the young ones, amounting to 50,000, were distributed.

Valdosta (Ga.) substation.—Development work was continued, and a second well, with a 16-inch casing was drilled. By means of the two wells Grassy Pond (between 200 and 300 acres in area) was drained by December. About 3,000 large bass were held in a pool of about 1½ acres for a future brood stock, with provision made for their escape when the pond refills to a point where it submerges the pool. All suitable bream were placed in Lot Pond (about 40 acres in area) as a future brood stock. Fifteen thousand bream fingerlings No. 2, 1,125 bass fingerlings No. 5, and 15,000 warmouth bass fingerlings No. 5 were given for the stocking of local waters, and about 2 tons of suckers and warmouth bass were carried away in sacks for use as food. Forty large alligators, some nearly 8 feet long, were shot in Grassy Pond during the year.

EDENTON (N. C.) STATION

[W. S. VINCENT, Superintendent]

Roach and fresh-water shrimp were introduced into the station ponds as a source of food supply, and the pond bottoms were fertilized. The negligible results attained with crappie having demonstrated the futility of further efforts with that species under present conditions, the pond formerly devoted to that work was used for bass culture. The production of bass fry exceeded all previous efforts by about 50 per cent and very favorable weather during the collecting period contributed to the good results. Auto trucks were again used to advantage in making the distributions. An attempt made to rear bass to fingerling size was not sufficiently productive to be considered a success. The poor results were probably due to a scarcity of protective aquatic vegetation. Among the more important of the minor improvements

made during the year were the addition of a bathroom to the cottage occupied by the apprentice fish-culturist and the rebuilding of the woodshed attached to the superintendent's residence.

LOUISVILLE (KY.) STATION

[HERMAN O. HESEN, Superintendent]

Electric fixtures were installed in the cottages occupied by the superintendent and the fish-culturist; and repairs were made on station buildings, ponds, and grounds as needed. The L type of outlet was installed in six of the ponds, and much time and labor were expended in mending leaks in the ponds and the sewer lines. All work outlined above with the exception of installing the electric fixtures was performed by the station personnel. The output of 412,157 fry and fingerling smallmouth bass indicates a smaller output than in the previous year, but if the 1930 production of 143,750 largemouth bass fry and fingerlings is taken into consideration the combined total exceeds the 1929 output of both species by a substantial margin. The records show that in past years very small results have followed the attempts made to propagate largemouth bass. The past year's output of the species was produced in one pond less than three-fourths of an acre in area, and the yield is considered good. The Hesen bass trap was used in making the collections. It seems very evident that the Louisville station is well located for the work in which it is engaged, both the climatic and the water conditions being well suited to pond cultural operations.

The year's distributions also included 1,280 bream and 2,740 rock bass, all fingerlings, in addition to 1,500 rainbow trout. The rainbow trout were obtained from the White Sulphur Springs (W. Va.) station for a special plant in Kentucky waters.

Owing to limited pond acreage the rearing of fish to the fingerling stage is not practicable at this station. Such fingerlings as were produced the past year were fish that had escaped capture in the breeding ponds when the fry distribution was made. The provision of additional pond facilities would permit of a material increase in the output of fingerling fish from this field.

MAMMOTH SPRING (ARK.) STATION

[DELL BROWN, Superintendent]

The usual work of keeping the station grounds in good condition was performed by the station force. Concrete floors were put in the fuel house and the workshop of the office building. The ornamental fence was painted and 600 feet of new fencing was built. The 8-inch portion of the station water main was replaced with a 10-inch pipe and valve, and made possible a considerable addition to the water supply. Of a total of 52 nests of the smallmouth black bass observed in the spring, only 36 were productive. The season's output of this species amounted to 58,000 fry and 35,139 fingerling fish. The schools of young bass of the largemouth species were unusually good, and a total of 205,500 fingerlings and 4,000 fry of that species was distributed. There was also a satisfactory output of rock bass. In addition to the station fish-cultural work over 650,000 pond fishes, principally black bass, were produced at four cooperative units in whose work the station actively participated. The most important of these establishments was the Arkansas State hatchery at Lonoke.

ORANGEBURG (S. C.) STATION

[S. A. SCOTT, Superintendent]

A 2-story frame building, 27 by 60 feet in dimensions, was constructed. This building provides room for a garage, meat room, tool room, and workshop on the lower floor and the upper story is used for storage space. The two small buildings formerly used as a garage, stable, and tool house were torn down, and a foundation was completed for a new office building, which will include in addition sufficient room for sleeping quarters and storage space. The superintendent's residence was painted inside and outside and the porches screened. All brood ponds were thoroughly cleaned during the fall and winter, the mud and vegetation in them removed, and the ponds sanded and graded

where necessary for proper drainage. Though interfered with to some extent by unfavorable weather, the general results of the year's fish-cultural efforts are regarded as satisfactory. Sudden temperature changes during the spawning season cut down the production of largemouth bass as compared with last year's figures. The 1930 output amounted to 323,455 fish of which approximately 200,000 were in the fingerling stage. The remainder were fry. Besides the bass work the distributions included 39,890 bluegill bream, 5,225 crappie, 4,860 warmouth bass, and 505 spotted catfish. In conjunction with the South Carolina Board of Fisheries two experimental shad hatcheries were constructed and operated in March and April, one of them being located on the Black River near Georgetown, S. C., and the other one 2 miles below Jacksonboro, S. C., on the Edisto River. At the former location 42,000 eggs were collected, while the collections on the Edisto numbered 560,000.

SAN MARCOS (TEX.) STATION AND SUBSTATIONS

[O. N. Baldwin, Superintendent]

Construction operations during the year were confined to repair of present station buildings. The outbuilding attached to the superintendent's residence was repaired and painted, and repairs were made to the station office. The superintendent's residence, office building, and cottages were piped for gas. The main sewer line in the well-basin trench, which had become stopped with roots, was opened and relaid. The flag mound was removed and a pond constructed on the site. The excavated earth was used for leveling the grounds and for the construction of a levee. The year's distributions of fish from San Marcos station included 213,417 fingerling black bass and 82,111 fish of other species, among which were 5,860 Rio Grande perch. Black bass were supplied to 154 applicants—an average of 1,386 being delivered to each. In making the distributions the station messengers traveled 24,411 miles, made 59 trips, and carried 8 species of fish.

Lake Worth (Tex.) substation.—In addition to fish-cultural work, the activities at this point were confined to care of ponds and grounds. The total output of fish amounted to 299,420, including 7,925 fingerling black bass and 96,200 crappie. The latter were rescued from flood waters of the Trinity River and placed in permanent waters within a reasonable distance from the station.

New Braunfels (Tex.) substation.—The total output of fish amounted to 88,041. Of these 10,361 were black bass and the remainder were bream and warmouth bass.

Medina Lake (Tex.) substation.—Fish to the number of 11,507 were distributed from this auxiliary. This number included 7,347 black bass, 3,070 sunfish, and 1,120 rainbow trout. The substation was closed late in September.

TUPELO (MISS.) STATION AND SUBSTATION

[Charles R. Wiant, Superintendent]

The year's fish-cultural activities were marked by an appreciable increase in the production of bream and a falling off in the output of bass. The total distribution of the two species of bream handled at the station, amounted to 398,385 fingerlings and yearlings, while the production of fry and fingerling bass aggregated 402,450. In a water temperature of 60° F. the adult bass began nesting on February 27, fully a month earlier than in any previous year. On March 3 the station was visited by a cold wave, which quickly lowered the temperature of the water to 39° F. and caused all brood bass to abandon their nests. The loss of eggs in this instance was total. The occurrence of a second cold spell on March 26 reduced pond temperatures from 67° to 44° F. This resulted in some loss of eggs and partially arrested the development of the fish, as all schools thereafter collected were small and many of them contained two or three sizes of advanced fry. At the close of the fall distribution in 1929 a lot of 41,000 bream was carried over the winter and shipped during the spring in connection with the bass distributions. The object of this was to avoid a duplication of transportation expenses, as both the bream and part of the bass were destined to the same section of the country.

The year's activities included no important construction work, and the few minor repairs needed on station buildings were attended to by the regular personnel.

Aliceville (Ala.) substation.—The combined output of black bass and bream from the four ponds available amounted to 46,950, which, under the conditions existing is regarded as a very satisfactory year's work. Practically all of these were delivered at the ponds to applicants who called for them. Another pond approximately 2½ acres in area, supplied by a flowing well, has been acquired for the work in this field.

LAKELAND (MD.) PONDS

[E. K. BURNHAM, acting in charge]

During the spring of the calendar year 1929 the four principal ponds of this system were stocked with largemouth black bass, crappie, and bream and were used for the culture of the same species in the spring of 1930. Golden shiners were planted as forage fish. The production resulting from these plantings was distributed during the fall months as fingerlings, with the exception of a few which were carried through the winter and planted as yearlings in the spring of 1930. The 1930 hatches were trapped and distributed as advanced fry before the close of the fiscal year. The total distribution from these ponds during this period amounted to 193,800 of all species.

CENTRAL STATION AND AQUARIUM, WASHINGTON, D. C.

[CHARLES W. BURNHAM, Superintendent]

The usual exhibit of live fish and aquatic animals was maintained in the Central Station Aquarium throughout the year. Two thousand four hundred and twenty-six individual specimens, representing 34 species, were shown in addition to eggs of the chinook salmon, cisco, and pike perch, which were displayed throughout their incubation and fry periods. Fry to the number of 2,607,500 were produced from eggs thus incubated, while 380,737 fish were distributed to applicants and planted in public waters in the Eastern States. Nearly all of the latter number were hatched at the Lakeland (Md.) or the Fort Humphreys (Va.) substation.

Part 2.—DISTRIBUTION OF FISH AND FISH EGGS

[E. C. FEARNOW, Superintendent of Distribution]

In view of the increased output of fingerling basses, trouts, and other inland fishes, the distribution problem was quite difficult, especially during the summer and fall months when the four cars were required to make shipments of fish from eight stations and substations. In addition to the 135 carload shipments of fish made during the year, detached messengers, traveling in baggage cars, made 1,235 trips direct from the stations, with each messenger carrying from 20 to 40 pails of fish.

The following table summarizes the distribution of fish and fish eggs during the fiscal year to applicants in the United States and its Territories. It also shows the plants of fish made by the bureau in public waters of the country in connection with the propagation of commercial fishes, and the salvage of fish from temporarily flooded lands.

Summary, by States, of the distribution of fish, fiscal year 1930

State and species	Number
Alabama:	
Catfish	1,125
Largemouth black bass	359,455
Sunfish	168,445
Alaska:	
Humpback salmon	1,389,000
Sockeye salmon	11,390,000
Steelhead salmon	82,000
Arizona:	
Largemouth black bass	1,000
Loch Leven trout	100,000
Sunfish	1,200
Arkansas:	
Rainbow trout	16,190
Crappie	1,565
Largemouth black bass	246,185
Rock bass	15,400
Sunfish	710
California:	
Chinook salmon	12,155,000
Steelhead salmon	200,000
Atlantic salmon	20,000
Rainbow trout	100,000
Loch Leven trout	50,000
Colorado:	
Catfish	1,200
Silver salmon	200,000
Steelhead salmon	350,000
Rainbow trout	1,257,500
Black-spotted trout	65,800
Loch Leven trout	1,327,000
Lake trout	135,000
Brook trout	4,041,300
Crappie	7,500
Largemouth black bass	6,800
Yellow perch	5,425
Connecticut:	
Loch Leven trout	200,000
Brook trout	17,800
Largemouth black bass	150
Delaware:	
Brook trout	2,000
Crappie	300
Largemouth black bass	1,111
Sunfish	300
District of Columbia:	
Largemouth black bass	100
Crappie	500
Sunfish	500
Florida:	
Largemouth black bass	5,150
Sunfish	600
Georgia:	
Catfish	2,575
Rainbow trout	685,950
Largemouth black bass	203,575
Warmouth bass	16,400
Sunfish	97,435
Idaho:	
Chinook salmon	3,019,000
Steelhead salmon	300,000
Rainbow trout	713,700
Golden trout	8,000
Brook trout	8,260
Smelt	12,000,000
Illinois:	
Catfish	3,880,000
Buffalofish	172,000
Carp	279,025
Black-spotted trout	13,200
Loch Leven trout	15,000
Pike and pickerel	820
Crappie	3,927,275
Largemouth black bass	11,040
Sunfish	454,900
Yellow perch	750
Miscellaneous	717,100
Indiana:	
Catfish	1,135
Rainbow trout	32,400
Brook trout	54,000
Crappie	3,750
Indiana—Continued.	
Largemouth black bass	3,515
Smallmouth black bass	192,300
Sunfish	10,730
Yellow perch	575
Iowa:	
Catfish	55,000,000
Buffalofish	78,150,000
Carp	79,000,000
Rainbow trout	15,100
Brook trout	1,600
Pike and pickerel	175,450
Crappie	2,434,350
Largemouth black bass	119,275
Sunfish	9,100,000
Pike perch	112
Yellow perch	175,637
White bass	140,930
Fresh-water drum	980
Miscellaneous	2,800,000
Kansas:	
Catfish	4,825
Crappie	1,750
Largemouth black bass	3,140
Sunfish	925
Kentucky:	
Largemouth black bass	143,595
Smallmouth black bass	138,409
Rock bass	6,640
Sunfish	1,280
Louisiana:	
Largemouth black bass	160
Rock bass	2,400
Sunfish	400
Maine:	
Landlocked salmon	821,830
Atlantic salmon	821,400
Brook trout	1,367,302
Crappie	400
Largemouth black bass	1,125
Cod	1,179,159,000
Haddock	124,920,000
Winter flounder	2,434,538,000
Maryland:	
Shad	446,000
Chinook salmon	7,500
Rainbow trout	210,100
Loch Leven trout	202,400
Brook trout	96,850
Crappie	400
Largemouth black bass	7,639
Smallmouth black bass	1,250
Sunfish	7,840
Massachusetts:	
Catfish	421
Landlocked salmon	5,000
Rainbow trout	82,608
Loch Leven trout	100,000
Lake trout	3,060
Brook trout	150,135
Pike and pickerel	400
Mackerel	16,502,000
Sunfish	25
Yellow perch	1,500,360
Cod	1,105,644,000
Haddock	131,840,000
Pollock	616,693,000
Winter flounder	902,051,000
Michigan:	
Whitefish	88,500,000
Cisco	100,000
Steelhead salmon	50,000
Landlocked salmon	10,000
Rainbow trout	179,700
Lake trout	29,461,000
Brook trout	729,500
Crappie	3,975
Largemouth black bass	19,300
Smallmouth black bass	6,200
Sunfish	9,090
Pike perch	6,690,000
Yellow perch	2,770

Summary, by States, of the distribution of fish, fiscal year 1930—Continued

State and species	Number
Minnesota:	
Catfish	4,614,841
Buffalofish[1]	75
Carp[1]	17,208
Whitefish	195,000
Rainbow trout	131,000
Loch Leven trout	151,500
Lake trout	91,000
Brook trout	258,500
Pike and pickerel	38,888
Crappie	3,453,665
Largemouth black bass	38,102
Sunfish	7,703,286
Pike perch	5,875,000
Yellow perch	1,905,825
White bass	3,210
Miscellaneous	5,693,208
Mississippi:	
Catfish	1,168,668
Buffalofish	29,000
Carp	693,100
Pike and pickerel	5,522
Crappie	3,884,712
Largemouth black bass	571,344
White bass	4,291
Fresh-water drum	372
Missouri:	
Rainbow trout	733,393
Crappie	2,425
Largemouth black bass	73,227
Rock bass	16,561
Sunfish	7,666
Montana:	
Rainbow trout	3,319,050
Golden trout	46,800
Black-spotted trout	2,969,350
Loch Leven trout	7,702,000
Brook trout	214,200
Grayling	1,100,000
Crappie	60,850
Largemouth black bass	57,202
Sunfish	11,675
Yellow perch	100
Nebraska:	
Rainbow trout	54,000
Loch Leven trout	47,000
Brook trout	72,000
Crappie	7,200
Largemouth black bass	1,400
Sunfish	146,550
Yellow perch	900
Nevada:	
Rainbow trout	901,500
Loch Leven trout	150,000
Brook trout	20,000
New Hampshire:	
Catfish	36
Chinook salmon	75,000
Steelhead salmon	7,000
Landlocked salmon	12,938
Rainbow trout	3,390
Brook trout	1,233,390
Largemouth black bass	3,225
Smallmouth black bass	13,100
Pike perch	500,000
Yellow perch	4,900,000
New Jersey:	
Catfish	400
Rainbow trout	1,500
Brook trout	10,000
Largemouth black bass	12,774
Sunfish	2,120
Yellow perch	128
New Mexico:	
Catfish	3,200
Steelhead salmon	137,500
Rainbow trout	12,000
Loch Leven trout	2,504,000
Brook trout	143,500
Largemouth black bass	9,890
Rock bass	7,250
Yellow perch	300
New York:	
Catfish	23,300
Whitefish	580,000
Cisco	27,850,000
Landlocked salmon	120,000
Rainbow trout	58,120
Black-spotted trout	10,000
Loch Leven trout	72,600
Lake trout	1,408,000
Brook trout	922,925
Crappie	2,200
Largemouth black bass	25,458
Smallmouth black bass	1,980
Sunfish	23,485
Pike perch	2,200,000
Yellow perch	5,800,000
North Carolina:	
Catfish	1,000
Shad	2,350,000
Glut herring	10,000,000
Rainbow trout	240,300
Loch Leven trout	150,000
Brook trout	126,900
Crappie	1,650
Largemouth black bass	320,075
Rock bass	300
Warmouth bass	235
Sunfish	45,820
Yellow perch	2,150,000
North Dakota:	
Catfish	1,000
Rainbow trout	2,000
Largemouth black bass	8,140
Sunfish	760
Yellow perch	2,900
Ohio:	
Catfish	2,675
Carp	2,600,000
Whitefish	62,940,000
Steelhead salmon	30,000
Rainbow trout	9,600
Brook trout	70,100
Largemouth black bass	8,850
Sunfish	2,386
Pike perch	108,000,000
Yellow perch	1,125,625
Oklahoma:	
Catfish	5,930
Rainbow trout	4,547
Crappie	9,060
Largemouth black bass	35,933
Rock bass	1,515
Sunfish	110
Oregon:	
Chinook salmon	2,095,000
Sockeye salmon	56,500
Silver salmon	373,800
Chum salmon	35,000
Steelhead salmon	3,425,660
Rainbow trout	157,250
Loch Leven trout	225,250
Pennsylvania:	
Catfish	17,640
Common sucker	6,750,000
Atlantic salmon	20,000
Rainbow trout	603,000
Loch Leven trout	296,300
Brook trout	2,031,000
Crappie	5,711
Largemouth black bass	29,865
Smallmouth black bass	50
Sunfish	25,990
Pike perch	25,585,000
Yellow perch	2,520
Rhode Island: Brook trout	20,000
South Carolina:	
Rainbow trout	41,500
Brook trout	40,500
Crappie	5,075
Largemouth black bass	253,305
Rock bass	2,175
Warmouth bass	3,560
Sunfish	37,915

[1] Rescued fish planted in the Mississippi River.

Summary, by States, of the distribution of fish, fiscal year 1930—Continued

State and species	Number
South Dakota:	
Rainbow trout	153, 350
Loch Leven trout	297, 900
Brook trout	746, 764
Crappie	26, 200
Largemouth black bass	13, 500
Yellow perch	4, 800
Tennessee:	
Rainbow trout	130, 650
Brook trout	9, 150
Largemouth black bass	72, 545
Smallmouth black bass	824
Rock bass	22, 455
Sunfish	18, 205
Texas:	
Rainbow trout	1, 120
Crappie	98, 925
Largemouth black bass	224, 784
Rock bass	1, 850
Warmouth bass	10, 505
Sunfish	382, 605
Rio Grande perch	5, 846
Utah:	
Silver salmon	526, 176
Rainbow trout	2, 126, 000
Loch Leven trout	270, 000
Brook trout	499, 000
Vermont:	
Steelhead salmon	11, 600
Landlocked salmon	45, 000
Rainbow trout	700
Lake trout	90, 000
Brook trout	1, 165, 118
Largemouth black bass	270
Smallmouth black bass	11, 500
Pike perch	15, 000, 000
Yellow perch	74, 800, 540
Virginia:	
Catfish	2, 000
Shad	1, 800, 000
Rainbow trout	278, 549
Loch Leven trout	8, 500
Brook trout	298, 200
Largemouth black bass	155, 737
Smallmouth black bass	575
Crappie	5, 300
Rock bass	25, 450
Sunfish	54, 850
Yellow perch	80, 150, 000
Washington:	
Chinook salmon	6, 485, 750
Chum salmon	24, 409, 000
Silver salmon	6, 232, 700
Sockeye salmon	15, 165, 190
Humpback salmon	3, 323, 300
Steelhead salmon	2, 967, 260
Rainbow trout	90, 000
Black-spotted trout	2, 422, 000
Brook trout	257, 700
West Virginia:	
Catfish	10, 450
Rainbow trout	204, 870
Loch Leven trout	136, 310
Brook trout	773, 660
Crappie	1, 430
Largemouth black bass	30. 085
Smallmouth black bass	81, 150
Sunfish	20, 455
Yellow perch	180, 465
Pike perch	800, 000
Wisconsin:	
Catfish	32, 914, 325
Buffalofish	55, 980
Carp	622, 665
Cisco	6, 000, 000
Rainbow trout	76, 650
Brook trout	1, 006, 300
Pike and pickerel	229, 915
Crappie	9, 068, 285
Largemouth black bass	75, 805
Sunfish	8, 495, 310
Pike perch	1, 650, 000
Yellow perch	540, 955
White bass	137, 111
Fresh-water drum	1, 005
Miscellaneous	9, 719, 800
Wyoming:	
Catfish	150
Black-spotted trout	10, 477, 000
Loch Leven trout	2, 454, 240
Brook trout	910, 395
Crappie	41, 300
Largemouth black bass	10, 400
Sunfish	9, 000
Yellow perch	4, 500

METHOD OF DISTRIBUTION

In making the distribution of fish it is the policy of the bureau to supply first the water from which the eggs are collected, after which shipments are made to suitable public and private waters on applications previously submitted. Blanks on which formal applications may be made will be furnished to applicants on request. Such blanks call for a complete description of the waters to be stocked and from the information furnished, the bureau assigns the species that are suitable.

Applicants are notified immediately as to the species that will be sent them and the approximate date of delivery and they are given instructions for receiving and caring for the fish. Before shipment is made a second notice is given, usually by telegram, stating the exact time of arrival of the fish at the railroad station. The fish are delivered at the applicant's railroad station free of charge and in the event that the shipment is delayed the applicant is notified accordingly.

Applicants are expected to provide suitable receptacles for carrying fish, such receptacles to be in readiness at the railroad station specified in the advance notice of delivery. The vessels should be uncovered and empty.

In making allotments of fish on applications the following items are taken into consideration: The area of water to be stocked, size and number of fish available for distribution, and the distance the fish must be transported. The bureau distributes fish as fingerlings or yearlings. At some stations, however, it is necessary to distribute a portion of the output as fry in order to prevent overcrowding.

The basses, sunfishes, and other pond fishes are distributed from three weeks to several months after they are hatched. The basses usually range from 2 to 6 inches in length, and the sunfishes from 2 to 4 inches in length. Commercial fishes, such as whitefish, yellow perch, etc., are produced in large numbers and are necessarily planted as fry. As a general rule the bureau delivers fish in the order in which the applications are received, and applications remain on file until delivery of the desired fish can be made.

Shipments of trout from the bureau's eastern stations are usually made during May and June, and applications received after April 1 will be carried on file for attention during the following year. The distribution of trout from stations in the Rocky Mountain region is made from May to October, and applications from that section should be submitted prior to May 1 in order to assure early delivery. Requests for bass, sunfish, and crappie should be on file with the bureau prior to May 1, as deliveries of such species are made between May and December.

During the year the bureau's cars traveled 115,497 miles of which 13,858 were free. Detached messengers traveled 390,356 miles of which 78,243 were free.

NEW DISTRIBUTION CAR

Near the close of the distribution in the fall of 1929 it was necessary to take out of commission car No. 3, for the reason that the car was very old, and, being of wood construction, was unsafe in modern steel trains. The condition of this car was forcibly brought to the attention of the bureau in a telegram from the Chicago, Milwaukee, St. Paul & Pacific Railroad Co. under date of October 16, 1929, as follows: "In interest of safety we can not undertake to handle U. S. fish car three account wooden construction, New Lisbon to Wausau tomorrow morning on train one naught three." The car at best could be used only on short trips, so it was brought to Washington and placed on a siding at Union Station.

While the bureau's new distribution car No. 10 has been completed and placed in commission, the service is still short one car. Car No. 10 takes the place of car No. 4, which was disposed of several years ago.

The distribution work is becoming heavier every year due to the increased output of fish, especially of the larger sizes. Years ago, when the bureau's output did not exceed 3,000,000,000 fish, it maintained 6 distribution cars. Only 4 cars are now available to handle an output of over 7,000,000,000 fish.

TROUT DISTRIBUTION

The distribution problem as pertains to trout is becoming more difficult each year, owing to the general tendency to produce large-sized fish.

When the distribution of trout is made during March or early in April it is possible to carry 1,000 to 1,500 small fish per can, while if the same fish were left at the station until September or October not more than 100 could be carried in a can. With its present facilities the bureau would not be able to handle the distribution of trout from its stations were it not for the assistance of a number of substations and cooperative plants. The fish are relayed to these plants at a time when they can be carried 1,000 or more to the can. In this way the distribution problem is minimized and the bureau is able to accomplish considerable more work than would be possible by making all distributions direct from its stations. One car of fry delivered to cooperative plants in the spring, under favorable conditions, will grow into 8 or 10 carloads of fingerling fish by the 1st of October. From the foregoing it will be seen that the intelligent assignment of fish to substations and cooperative projects enables the bureau to perform eight or ten times more work than would be possible if such facilities were not available.

The distribution from cooperative projects is simplified by the fact that their location is in proximity to the streams that are to be stocked enabling shipments to be handled by trucks at a nominal cost. Moreover, the sportsmen often proffer their services and automobiles for making plants of fish from cooperative projects sponsored by their organizations.

In order to properly supply the various cooperative projects throughout the country it is necessary to remove during the months of April, May, and June approximately 30 carloads of small trout. This work is, of course, in addition to the general distributions which the bureau conducts from its stations to applicants who have not the facilities for rearing fish in troughs but plant them direct in suitable waters. The generally increasing demand for fish from 3 to 6 inches in length—large enough to take care of themselves in open waters—is reflected in the output of practically every hatchery of the bureau.

The Bozeman (Mont.) station formerly distributed its output as fry and small fingerlings, but last year it reared brook trout until they were 3 and 4 inches in length. To make a proper distribution of these fish, a car was required in the State of Montana from July 1 until along in November.

The Craig Brook (Me.) station last year, in addition to its general distribution made during the months of May and June, reserved several hundred thousand fish, consisting of brook trout and landlocked salmon. The distribution during the fall months was handled by special messengers with the assistance of one of the distribution cars at a time when the services of the car were urgently needed in connection with the general distribution from the rescue stations along the Mississippi River.

Another plant that within recent years has been producing large numbers of trout is the bureau's semicooperative project in connec-

tion with the Jefferson County Rod and Gun Club of Watertown, N. Y. The bureau's station at Cape Vincent, N. Y., is equipped for incubating large numbers of trout, but does not have the facilities for rearing them until they are 3 or 4 inches in length. Large numbers of these trout are transferred early in the year to the Watertown nursery and reared until the 1st of October. Were the distribution made direct from the Cape Vincent station early in the spring, there would not be more than 300 cans of fish, but when reared until fall at Watertown there are several thousand cans.

The same tendency to produce large-sized fish exists at the Nashua, Hartsville, Neosho, and Leadville stations.

COOPERATION WITH THE UNITED STATES FOREST SERVICE

Of all the work accomplished by the bureau in the stocking of inland waters, none is of more importance than that which pertains to keeping up the supply of game fishes in the national parks and forest preserves. These great recreation grounds are visited annually by millions of tourists, a majority of whom are interested in fishing. The problem of maintaining a supply of fish in park waters is becoming, therefore, more acute with the increased popularity of angling. The efforts being made to keep up the supply of fish in forest preserves are set forth in the report of R. Y. Stuart, Forester, which follows:

The following summary on fish distribution presents the data by States and regions for the season of 1929. The data for the season of 1930 were inadequate to afford detailed information at this time, but it is understood that at least the number of fish indicated in the total, or over 37,000,000 exclusive of region 6, will be required for the next year.

Region	State	Planted 1929
1	Idaho	15,263,000
	Montana	767,500
	Washington	390,000
	Total	16,420,500
2	Colorado	3,532,500
	Nebraska	1,500
	South Dakota	159,000
	Wyoming	1,635,200
	Total	5,328,200
3	Arizona	1,509,034
	New Mexico	1,358,415
	Total	2,867,449
4	Idaho	3,355,313
	Nevada	493,750
	Utah	4,391,175
	Wyoming	661,480
	Total	8,901,718
5	California	2,865,409
7	Alabama	21,000
	Arkansas	23,250
	New Hampshire	256,750
	North Carolina	243,500
	Tennessee	43,037
	Virginia	43,500
	West Virginia	89,300
	Total	720,337
	Grand total	37,103,613

Forester Stuart summarizes conditions in the national forests, as follows:

(1) As a general rule national forest streams are declining in numbers of fish. Potentially they are capable of meeting the demand of ever-increasing recreational use.

(2) The main causes for the reductions in fish are: (*a*) Increased demands due to the increased travel in the national forests, and (*b*) the number of fish planted is wholly inadequate in consideration of the losses which occur in planting.

(3) There is a lack of coordination of effort and cooperation among different agencies interested in restocking streams.

(4) There is inadequate basic information on the adaptability of streams to different species and the capacity of such streams.

FIGURE 4.—Planting trout in national park waters

(5) There is too much loss in transplants due to size of fish turned into streams, the lack of proper handling facilities, inadequate arrangements among cooperative agencies, and inexperience in the technique of transplanting by some of those entrusted with the care of fish.

FIGURE 5.—Landlocked salmon and eastern brook trout from national forest waters. These fish were planted in 1921 and caught in 1923

(6) Losses from irrigation ditches are enormous, and while some progress has been made in the development and installation of screens there is inadequate supervision and attention given to this phase of the question.

(7) Little is known of the losses due to predators in the form of either fish or animals and birds, or the proper balance that might be maintained between our fur bearers, bird life, and fish.

(8) The laws of the various States lack uniformity and scientific basis of regulation of catch.

(9) Adequate control of forest cover through the prevention of fires or its destruction by other means is not sufficiently appreciated.

DISTRIBUTION CARS

CAR NO. 3

[E. K. BURNHAM, Captain]

Early in July, 1929, messengers were engaged in the distribution of trout from La Crosse, Wis., to cooperative nurseries and continued making isolated trips from various stations until after the middle of November. Being of wooden construction, the car could be moved in local trains only. The fish moved by messenger trips direct from stations in regular distributions are as follows:

Species	Fingerlings					Yearlings	Adults
	No. 1	No. 2	No. 3	No. 4	No. 5		
Catfish			75	1,650			
Rainbow trout		14,500					
Crappie		1,100	5,900			985	425
Largemouth black bass		3,750	9,465	1,665	1,255	1,560	30
Sunfish	36,350	16,400	750	2,885		2,089	
Yellow perch			4,900	1,750			
Total	36,350	35,750	21,090	7,950	1,255	4,634	455

The car traveled 10,028 miles and made 14 trips. The first carload was trout taken from the Manchester (Iowa) station on July 9 and the first carload of spiny-rayed fishes was taken on at La Crosse, Wis., August 22.

The following table shows the number, size, and species of fish moved by the car direct from stations during the fiscal year:

Species	Fingerlings					Yearlings	Adults
	No. 1	No. 2	No. 3	No. 4	No. 5		
Catfish		3,000	4,075	3,000	510		108
Buffalofish							8
Rainbow trout	31,500	2,000					
Black-spotted trout							9
Grayling							18
Pike and pickerel							12
Crappie	1,500	2,250	12,845	480		450	139
Largemouth black bass		5,400	35,710	11,990	3,645		136
Smallmouth black bass			1,100				
Rock bass							30
Strawberry bass							30
Sunfish	22,500	2,000	3,285	12,150			192
Yellow perch		1,200	10,350	150	1,130		
Total	55,500	15,850	67,365	27,770	5,285	450	682

Car No. 3 arrived at Washington, D. C., November 21, 1930, and was taken out of commission on account of its unsafe condition.

CAR NO. 7

[E. R. WIDMYER, Captain]

The distribution of brook and rainbow trouts was carried on from the Manchester (Iowa) station during the early part of the fiscal year, the car making a trip from Manchester to Eau Claire, Wis., delivering 60,600 2-inch brook trout and 24,700 1-inch rainbow trout to Wisconsin applicants.

The distribution of warm-water species was begun from the river stations on August 21, when the car made a trip from La Crosse, Wis., to Des Moines, Iowa, taking fish from Homer, La Crosse, Marquette, and Bellevue stations. On completion of the Des Moines trip the car returned to Marquette and made a trip from Marquette, Iowa, to Duluth, Minn. After completing the Duluth trip the car returned to La Crosse and made a trip from that point to Bay City, Mich. From Bay City the car returned to Marquette, Iowa, where a load of fish was obtained for Columbus, Ohio. On completion of the Columbus trip the car returned to La Crosse where it received a load of fish for Madison, Wis. From Madison the car proceeded to Bellevue, Iowa, where it obtained a load of fish for waters in the vicinity of Pittsburgh, Pa., and on completion of this trip it was ordered to Fairport, Iowa. After making the Syracuse, N. Y., Albany, N. Y., and Cumberland, Md., trips from Fairport the car returned to Bellevue, Iowa, where it obtained a load of bass, bream, etc., for waters in the vicinity of Clarksburg, W. Va. From Clarksburg the car returned to Bellevue and was loaded with 249 pails of river fishes for waters at Cambridge Springs, Pa., returning to La Crosse on completion of the trip.

From August 21 to November 11, car No. 7 made 12 long eastern trips from the rescue stations, carrying from 249 to 252 pails and making as many as 9 messenger shipments on a single car trip. On the car's arrival at La Crosse from Cambridge Springs it was directed to proceed to Lynxville, Wis., from which station it made 2 trips to Miles City, Mont., and 1 trip to Trempealeau, Wis., with brood stock. The distribution from the rescue stations closed November 27 at which time the car was returned to La Crosse and placed on steam tracks of the Milwaukee road where it was held until January 8.

The car was placed in the Milwaukee shops at Milwaukee, Wis., on January 9 for annual repairs. The repair items of most importance were the refinishing of the car's interior, painting of exterior, removal of electric wiring from the interior ceiling to outside top of car, the removal of wall-board ceiling and the replacing of same with white wood veneer, and the simplifying of the air line to prevent the sticking of the brakes. While the car was in the shops the crew was left at La Crosse to renew the aerating equipment of the car and to give the transportation pails a complete overhauling and thorough cleaning.

The car left the shops on February 27 and arrived at La Crosse on February 28. The equipment of the car was replaced and a trip made with 200,000 brook trout and 50,000 rainbow trout from La Crosse to the Lynxville holding station. A messenger shipment of 100 adult bream was made from La Crosse to Crawford, Nebr., on April 19, for brood stock at the Crawford station.

The car left La Crosse on April 28 with a load of trout for Wisconsin applicants. After the trip was completed the car proceeded to Duluth, Minn., and took up the distribution of lake trout, lake herring, whitefish, pike perch, and brook trout from the Duluth station.

After making 6 car trips, 3 boat trips, and a number of messenger shipments from the Duluth station, the car proceeded to Manchester, Iowa, and made 1 trip to Waupaca and 1 trip to Milwaukee, Wis., completing this work and returning to La Crosse on July 26.

During the fiscal year 1930 car No. 7 made 27 trips, traveled 26,232 miles, and delivered 24,095,787 fish. Messengers made 94 trips and traveled approximately 48,000 miles. The following table shows the number, size, and species of fish delivered by car and crew:

Species	Fry	Fingerlings Nos. 1 to 6	Yearlings	Adults
Catfish		49,420	1,740	100
Lake Herring	6,100,000			
Whitefish	3,195,000			
Rainbow trout		103,652		
Loch Leven trout		26,650		
Lake trout	6,391,000	45,000		
Brook trout		457,100		
Crappie		10,280	2,435	1,532
Largemouth black bass		74,440	40	2,074
Smallmouth black bass		5,980		
Sunfish		58,105	8,370	3,369
Pike perch	7,540,000			
Yellow perch		13,395	945	160
Total	20,226,000	844,022	13,530	7,235

CAR NO. 8

[T. H. COPELAND, Acting Captain]

At the beginning of the fiscal year car No. 8 was engaged in moving a carload of adult yellow perch from Seneca, Nebr., to Strang, Okla., and on completion of this trip proceeded to Malta, Colo., where the distribution of trout from the Leadville station was begun. During this distribution, car No. 8 made 7 trips from Malta to points in Colorado and moved 1,470 pails of fish, or 1,809,000 brook, rainbow, and black-spotted trout. Messengers on detached trips moved 426,000 brook, 10,000 black-spotted, and 95,000 rainbow trout. The car completed the Leadville distribution of August 30, and moved to Bellevue, Iowa.

The car loaded at Bellevue on September 6 with 210 pails of miscellaneous river fishes for points in Massachusetts, Connecticut, and Maine. On completion of this trip the car continued on to Bucksport, Me., and made trips from that point to Dover-Foxcroft, and Grindstone, Me., moving 420 pails of fish which completed the Maine distribution.

Car No. 8 returned to Marquette, Iowa, and loaded on August 19 with 210 pails of miscellaneous river fishes for applicants in northern Michigan, returning to Marquette, where another load of fish was obtained for delivery in Missouri. On completion of this trip the car returned to Neosho, Mo., where 2 carloads of fish were moved to nursery ponds. After completing the Neosho distribution, the car proceeded to Langdon, Kans., where 5 car trips were made from the Langdon station to points in Oklahoma, Kansas, New Mexico, and Tennessee. During this distribution 1,133 pails of black bass, bream, crappie, rock bass, catfish, and yellow perch were distributed in various streams in the above-mentioned States.

On November 9 the car moved 210 pails of pond fishes from the Langdon station to points in New Jersey and Pennsylvania, returning to Marquette, Iowa, where a load of miscellaneous river fishes was obtained and distributed in Pennsylvania. The car arrived at Washington, D. C., on November 25, and the crew was detailed to the various stations for winter work.

On January 15 car No. 8 was placed in the Pennsylvania railway shops at Wilmington, Del., for annual repairs. The work was completed on February 20 and the car returned to Washington, D. C.

The car left Washington April 4 for White Sulphur, W. Va., where 150,000 trout were obtained and distributed to cooperative nursery ponds in the vicinity of Scranton, Pa. On completion of this trip the car returned to Fishery, Tenn., to take up the trout distribution from the Erwin (Tenn.) station. During the Erwin work the car moved 4 carloads of fish to points in North Carolina, South Carolina, Georgia, and Virginia.

Upon completing of the Erwin distribution on April 30, the car moved to Wytheville, Va., and obtained 40,255 rainbow trout for applicants at Hazleton and Scranton, Pa. The car proceeded from Hazleton, Pa., to Great Barrington, Mass., where 84,000 brook trout were received and delivered to applicants in Pennsylvania, returning to White Sulphur, W. Va. The car moved 3 loads of fish from the White Sulphur station to points in Virginia, West Virginia, Pennsylvania, and Ohio, and then proceeded to La Crosse, Wis. At the close of the fiscal year the car was completing the Manchester, Iowa, distribution.

During the year the car traveled 32,819 miles, made 36 trips over 31 roads, and delivered fish in 27 States. Detached messengers made 124 trips, traveling approximately 40,000 miles away from the car. The following tabulation will show the number, size, and species of fish delivered by car No. 8 and messengers operating from the car.

Species	Fry	Fingerlings				Yearlings and adults
		No. 1	No. 2	No. 3	No. 4	
Catfish			9,400	9,150	2,300	2,580
Atlantic salmon				90,400		
Landlocked salmon					3,500	
Rainbow trout		535,600	329,900	68,600	20,100	1,155
Black-spotted trout		46,000		21,000		
Loch Leven trout		131,000	34,600			
Brook trout		2,380,000	491,950	159,650	2,000	
Crappie			2,875	9,810	900	75
Largemouth black bass	119,000		15,175	73,960	9,875	6,593
Rock bass			5,000		375	
Bream		2,800	35,210	8,075	3,380	1,560
Yellow perch				3,000	970	2,000
Total	119,000	3,095,400	924,110	443,645	43,400	13,963

CAR NO. 9

[F. W. A. Englehardt, Captain]

At the beginning of the fiscal year, car No. 9 was engaged in the distribution of trout from the Bozeman (Mont.) station. Twenty-two trips were made to points in Montana, Idaho, Washington, and Wyoming. Early in September the car proceeded to Miles City, Mont., to take up the distribution of black bass and other warm-water fishes. Shipments were made to points in Montana, Wyoming, and South Dakota. In November the car returned to Bozeman to receive fingerling trout for distribution en route east and adult specimens for the Washington, D. C.; Lincoln Park, Chicago, Ill.; and La Crosse, Wis., aquariums and the Milwaukee, Wis., museum.

A trip with river fish was made from Marquette, Iowa, to points in Indiana, Ohio, and Michigan, the car returning via Chicago to Bloomington, Ill., in December to be placed in the Chicago & Alton railroad shops for annual repairs. New tubes were installed in the boiler and general repairs made to the car and running gear. Early in March instructions were received to proceed to Charlevoix, Mich., and begin the distribution of lake trout and whitefish and upon completion of this work the car proceeded to Northville, Mich., and took up the distribution from that station. Early in May the car proceeded to La Crosse, Wis., where it made a number of shipments returning to Bozeman, Mont., in June making 4 carload plants from the Bozeman station before the close of the fiscal year.

During the fiscal year car No. 9 made 50 trips traveling 34,932 miles and delivering 12,762 pails of fish to 949 applicants. The following table shows the species, number, and size of fish delivered:

Species	Fry	Fingerlings						Yearlings and adults
		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	
Catfish				3,400				100
Whitefish	19,600,000							
Rainbow trout		476,500	327,600	106,460	129,850			4
Black-spotted trout		956,600	22,000					35
Loch Leven trout			252,390	14,400	7,500			18
Lake trout	2,600,700							
Brook trout		683,000	626,000	132,675	391,170	1,500	3,750	5
Golden trout		8,000						200
Grayling								74
Crappie			146,350	1,600				280
Largemouth black bass				103,850	3,750			
Bream		11,000			25			6,510
Yellow perch				450	13,975	400		120
Total	22,200,700	2,135,100	1,374,340	362,835	546,270	1,900	3,750	7,346

CAR NO. 10

[E. M. Lamon, Captain]

This car was built by the Bethlehem Steel Co. at their Harlan plant, Wilmington, Del., during the fiscal year and was completed on December 28. The car arrived at Washington on January 2 where part of the crew was assembled and the work of placing loose equipment aboard and fitting the car out for transporting fish was taken up. After completing this work the car was ordered to White Sulphur Springs, W. Va., arriving at that point on March 17.

On March 18, 483,400 fingerling trout were obtained from the White Sulphur Springs station and transported to Keyser, W. Va., for stocking a nursery near Petersburg, W. Va. After completing this trip the car returned to Washington, D. C.

Messenger shipments were forwarded from Washington, D. C., during the latter part of March to Moorestown, N. J.; Cresco, Pa.; Richmond, Va.; and Martinsburg, W. Va., delivering 180,000 yellow perch fry, 800 yearling yellow perch, and 75 adult brook trout to applicants at these points.

The car was ordered to proceed to White Sulphur Springs, W. Va., on April 6 to take up the distribution from that station. Trips to Williamsport, Altoona, Connellsville, and Latrobe, Pa., were made during April, delivering 535,000 fingerling brook trout, 155,400 fingerling rainbow trout, and 103,800 fingerling Loch Leven trout to cooperative nurseries and applicants in Maryland and Pennsylvania.

After completing the trip to Latrobe, Pa., the car proceeded to Cumberland, Md., where the crew assisted in seining the ponds at Lakewood hatchery near Cumberland. These ponds yielded 288 yearling black bass, 100 yearling sunfish, and 150 yearling catfish, which were delivered to applicants in Maryland and Pennsylvania. The work was completed on May 4 and the car then proceeded to Washington.

On May 8, 350 yearling black bass and 55 adult black bass were delivered to the car at Washington from the Fort Humphreys (Va.) station. The car left Washington on the morning of May 9 and proceeded to Elizabeth, N. J., where these fish were delivered to the Union County Park Commission. After completing this trip the car returned to White Sulphur Springs, W. Va., to continue the distribution from that station.

Trips to Williamsport, Allentown, Oil City, and Stroudsburg, Pa., were completed between May 10 and June 7 delivering 208,500 fingerling brook trout, 33,400 rainbow trout, and 127,800 Loch Leven trout to applicants in New York, New Jersey, Maryland, Pennsylvania, Virginia, and West Virginia. During May, messengers operating from the car, delivered 48,000 black-bass fry, 40 adult black bass, and 70 yearling sunfish from Washington to points in North Carolina, Ohio, and Virginia. The distribution from the White Sulphur Springs station was completed on June 7 and the car was ordered to Bucksport, Me., arriving at that point on June 16.

On June 18, 95,900 fingerling brook trout and 23,200 fingerling landlocked salmon were obtained from the East Orland (Me.) station and the car proceeded to Vanceboro, Me. These fish were distributed to applicants at various points along the Maine Central Railroad between Bangor and Vanceboro. After completing this trip the car returned to Bucksport. On June 21, 106,050 fingerling brook trout were obtained from the East Orland (Me.) station for delivery to applicants in Pennsylvania and nursery ponds at Catoctin, Md. The car arrived at Frederick, Md., on the morning of June 23 and the fish were transported from Federick to the nursery ponds by truck. After completing this work the car returned to Washington, D. C.

From March 16 to June 30, car No. 10 made 12 trips and traveled 11,486 miles. Detached messengers made 60 trips and traveled 11,048 miles. The following tabulation will show the number, size, and species of fish delivered.

Species	Fry	Fingerlings			Yearlings	Adults
		No. 1	No. 2	No. 3		
Catfish					150	
Landlocked salmon		23,200				
Rainbow trout		53,400	155,400	33,400		
Loch Leven trout		130,000	151,600			
Brook trout		798,000	387,950	139,550		75
Largemouth black bass	48,000				638	95
Sunfish					170	
Yellow perch	180,000				800	
Total	228,000	1,004,600	694,950	172,950	1,758	170